



THE BIG FIVE AS A BASIS FOR MODELING PERSONALITY
A WHITE PAPER

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The Big Five as a Basis for Modeling Personality

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Abstract: *In order to use personality in modeling human behavior, the developer must choose a way to represent personality. Three popular ways to represent personality, the Myers Briggs Type Inventory, the Minnesota Multiphasic Personality Inventory, and NEO Personality Inventory Revised are considered for this purpose. The strengths and weaknesses of using these tests as a basis for modeling the behavior of individuals are discussed. The NEO Personality Inventory with its emphasis on the big five personality domains is recommended, and suggestions are provided as to how it can be used.*

1. Introduction

One source of variability in human behavior is the individual's personality. A personality profile summarizes behavioral tendencies that, when considered with other variables such as cognitive style, cultural influences, and personal experiences can be useful in modeling an individual's behavior. A developer that elects to include personality variables within a human behavior model must choose a way to represent personality. This paper proposes several characteristics to consider in selecting a personality representation, compares three methods of developing personality profiles, and suggests an approach that can be employed using one of these methods. The human behavior modeling application that guided this investigation was the discrimination among alternative courses of action as a function of an individual's personality profile.

2. The Relevance of Structured Tests

Although a human behavior model is not a psychological test, parallels between using a personality profile to model behavior and developing a structured personality test suggest that such tests are a good place to start. A structured personality test infers traits based on a limited behavior sample (such as a paper and pencil test) in order to permit the user to generalize the expression of these traits within a different behavioral domain. For example, favorably endorsing the statement, "I always check my work", provides a sample of behavior that might relate to the personality trait "conscientiousness." This trait name has utility as a descriptor because it relates to a variety of specific behaviors. Thus, implicit in the process of constructing and using a personality test are the assumptions that a set of traits provide a summary of an individual's behavioral tendencies (personality), that these behavioral tendencies generalize across a variety of

behaviors, and that the traits can be accurately assessed by a test. The constructs that personality tests purport to measure may be labeled personality types, traits, scale scores, factors or dimensions. Regardless of label, they perform the same function; they are constructs that mediate a relationship between a sample of known behaviors and a set of forecast behaviors.

A model developer must consider the same issues as a test developer. What set of personality traits provide the highest fidelity representation of enduring behavioral tendencies? How well do these traits generalize to the specific behaviors of interest to me? And lastly, if I am modeling a specific individual, how do I assign these traits? If the model is to be valid, then the model developer faces the same validation task as the test developer. The model developer must demonstrate that the traits are accurately measured and that the behavioral inferences drawn from them are valid. Demonstrating the validity of the model dictates adherence to many of the same psychometric principles that govern test construction. The extensive effort required, however, in obtaining psychometric data for a model is likely to exceed the cost of the model itself. As an alternative, traits assessed by tests having good psychometric properties can be selected.

3. Desirable Characteristics of Personality Measures

If personality profiles are to be selected on the basis of structured personality tests, then what are the characteristics of tests that might make some tests better suited to that purpose than others? The following paragraphs suggest some characteristics to be considered.

3.1 Reliably measured

Reliability refers to the extent to which repeated measurements produce the same outcome. A universally accepted personality construct would be of little use if it could not be assessed reliably. Reliability for personality tests is most often reported as either test-retest correlation coefficients, or internal consistency coefficients (correlation among items purporting to measure the same construct). Reliability is by its nature concerned with the method of measurement. Because the individual is the best source of information about herself or himself, it is common for personality tests to use self-reported behaviors to infer the existence of traits. For many applications, however, self-reports may not be obtainable. For example, a public figure or military leader may not disclose data. In such cases, traits must be inferred on the basis of a sample of observed behavior (e.g. biography, intelligence summaries, writings, speeches, etc.). For this reason reported good reliability from 'ratings by others' is a desirable characteristic of a structured test used in modeling.

3.2 High percentage of personality variance

The more fully the individual's personality is described the more accurately behavior can be modeled. The completeness of a set of traits measured by a particular test is therefore an important consideration. Some tests report statistical evidence of the variance in personality accounted for by the traits measured. Further, reviewers are quick to point out traits that are not well represented by specific tests. Their critiques can also be used to ensure that the set of traits selected provide a reasonably complete framework for describing personality.

3.3 Traits – behavior associations

Within a model personality may be related to behaviors through a network of propositions that originates in abstract traits and terminates in concrete behaviors. The validity of the propositions within the network determines the power and accuracy of the model. To the extent that one behavior can be inferred from the existence of another behavior or trait, a proposition is valid. A great deal of empirical research goes into demonstrating the validity of structured tests. Ideally, empirical evidence should support the validity of each proposition in a model as well. To do so, however, is expensive and time consuming. Thus, the developer will be required to insert propositions that are simply face-valid, that is, that appear to be related to each other on the basis of common experience. The use of easily understood traits having clear behavioral associations reduces the risk that a face-valid proposition will prove to be unfounded. The measurement of traits by clear behavioral statements and

the rich verbal descriptions of those traits is a useful characteristic of a test because they make the trait easier for the developer to use.

3.4 Applicability across cultures

Two advantages accrue from using personality traits that have been recovered within multiple cultures. First, research results are more likely to generalize to populations of interest. Personality traits recovered across multiple cultures are more likely to have a genetic basis that enhances their universal applicability. Extending the use of these traits to an untested population entails less risk. Second, universal traits are likely to be more easily recognized by raters as familiar behavioral tendencies. Just as it is important for people to be able to read the emotional states of others, so also is it important that basic behavioral tendencies be recognizable. Universal traits that have a genetic basis are likely to be exhibited in a variety of recognizable ways that can facilitate assessment in any culture.

3.5 Orthogonal, continuous, with normative data

Measurement of multiple orthogonal traits along continua facilitates capturing subtle variations in personality profiles that should ultimately increase the validity of a human behavioral model. A trait is not particularly useful without norms that place the trait in context. Normative data are also important in understanding the relative importance of traits within an individual's personality profile. Traits exhibited to an extreme degree may dominate a personality. Conversely, traits present in normal amounts may not differentiate a personality in a useful way.

4 Review of Tests

There are many personality tests in use. The paragraphs below discuss three tests that could provide a basis for personality modeling. These tests were chosen because they are both well known and reflect different approaches to personality test construction. Each test is described briefly then discussed with respect to the desirable characteristics

4.1 Myers Briggs Type Indicator (MBTI)

The MBTI is a pencil and paper, forced choice, self-report instrument, having 94 scoreable items assessing eight traits measured on four bi-polar scales (Extravert/Introvert, Sensing/Intuiting, Thinking/Feeling, Perceiving/Judging). The test, created by Isabel Myers and Katherine Briggs, was constructed to measure a theory of psychological types advanced by Carl Jung. Test items contain behavioral statements consistent with

the theory that inspired the test. The MBTI returns 16 – four letter personality designators formed by forcing the selection of one of the two descriptors from each scale. General behavioral tendencies of each type are described in the test materials (Myers & McCauley, 1989).

4.1.1. Strengths

The MBTI may be the most popular personality test in use today. It is used extensively for career counseling and management/team building. Although the writer did not view any predictive validity data for these applications, the continued popularity of the MBTI for more than 50 years provides a de facto measure of its validity. Construct validity has been demonstrated by significant correlations between MBTI scores, behaviors reflective of MBTI constructs, and persons' self-assessments of their own MBTI types (Barbuto, 1997). In a meta-analytic study, mean reliability scores were found to be excellent, ranging from a low of .764 on the Thinking/Feeling scale to .843 on the Sensing/Intuiting scale (Caparo & Caparo, 2002).

4.1.2. Weaknesses

The chief weakness of using the MBTI as a basis for modeling personality lies in the dichotomous assumption concerning the traits it measures. The MBTI produces dichotomous types. Individuals with widely differing responses to items could nevertheless be typed in the same way. Barbuto (1997) points out that the test is often wrongly operationalized as continuous scales. The confusion may have arisen because types are often shown as a numerical preference of one pole over the other, as for example, extraversion versus introversion. Jung held that a person is either an extravert or introvert. Individuals may differ, however, in the level of self-awareness of type. Thus, the magnitude of the score should be interpreted, not as an indication of more extraversion or introversion, but rather that the respondent is more self aware concerning the possession of that trait (Myers & McCauley, 1989). Barbuto has argued that such dichotomous, non-continuous scales will not be able to account for differences in behavior of individuals with the same personality type (Barbuto, 1997). This criticism is particularly trenchant when applied to using the MBTI traits as the basis for a model.

There is evidence that the MBTI is not a comprehensive measure of personality. One personality component consistently reported by other researchers, neuroticism, has not been recovered by the MBTI (McCrae & Costa, 1989; MacDonald, Anderson, Tsagarkis, & Holland, 1995). Further, even though the MBTI is theory driven, its relationship to theory can be questioned. Jung proposed two attitudes (extravert/introvert) that can be

paired with any one of four functions: sensing, intuiting, thinking, and feeling. This 2 by 4 representation gave rise to eight two-letter personality types formed differently from the 16 proposed by Myers and Briggs (after adding a fourth scale) (Barbuto, 1997). Thus, the theory may have been extended beyond its founder's original intentions.

4.1.3. Conclusion

The MBTI provides an interesting profile of individual temperament types. Its enduring success appears predicated on the assumption that people with the same temperament will gravitate toward the same interests, occupations, and roles within organizations. Much of its success may also derive from the extraversion/introversion scale, a factor that shows up consistently in other studies. The other scales appear to be unique to the MBTI and could well be accounted for as components of different personality factors. The scales of the MBTI ultimately produce personality types. Description and norms exist at the level of type. To equate individual scales to traits and use them within a model as if they were orthogonal dimensions of personality has questionable validity. Thus, the scales of the MBTI do not necessarily constitute the best choice for the modeler.

4.2. Minnesota Multiphasic Personality Inventory (MMPI).

The oldest and most researched personality test is the Minnesota Multiphasic Personality Inventory (MMPI) (Miller & Shelley, 2000). Greene (1991) provides a full discussion of the instrument. The MMPI and its successor, the MMPI-2, contain over 550 true-false, self-report, largely self referent items selected to measure ten clinical scales (Hypochondriasis, Depression, Hysteria, Psychopathic Deviate, Masculinity-Femininity, Paranoia, Psychasthenia, Schizophrenia, Hypomania, Social Introversion) and three validity scales. When the MMPI was developed, the use of face valid, self-report items was being questioned on the grounds that respondents could determine how they wished to portray themselves. As a consequence, a more empirical approach was followed. A large pool of items without obvious scale associations was administered to both control and criterion groups (psychiatric inpatients). The items that were able to differentiate the criterion groups from the control groups were subsequently included in the MMPI. Validity scales were also added to specifically detect respondents who attempted to portray themselves either favorably or unfavorably. As a result the MMPI does a good job of what it was expressly constructed to do, help diagnose certain types of psychopathology.

4.2.1. Strengths

The strength of the MMPI lies in its norms. Raw scores on each scale are converted to standard t scores. Results are typically interpreted in terms of the scales having t scores at least one standard deviation above the norm. Typically, personality types are expressed in terms of elevated scales, such as 2-4 (Depression-Psychopathic Deviate). This process of developing scale norms and typing personalities based on salient traits recognizes that certain traits can dominate an individual's behavior. A clinician skilled in interpreting the MMPI is able to describe abnormal personalities by reading the pattern of elevated scales. The MMPI has been demonstrated across cultures as well.

4.2.2. Weaknesses

Although there is a wealth of items to rate, the self-referent nature of these items make it unclear that even an intimate friend would be able to rate another. Further, the scales were not designed to be orthogonal. Intercorrelations among scales are high (nor surprising since some items contribute to two scales). Factor analyses have suggested that the MMPI measures only two factors, suggesting that it fails to capture personality fully.

One weakness that renders the MMPI inappropriate as a basis for personality modeling is its failure to account for a high percentage of variance in the normal personality. The MMPI was developed to detect psychopathology. It was not designed to measure variation within normal personalities. Thus, the items do not differentiate in a meaningful way among the general population.

4.2.3. Conclusion

The MMPI scales were developed specifically to detect certain types of psychopathology and abnormal personalities. The MMPI scales do not provide a useful basis for modeling normal personality.

4.3. NEO Personality Inventory – Revised (NEO-PI-R)

The NEO-PI-R is an instrument designed to measure what has come to be known as the big five personality factors. The instrument, developed by Peter Costa and Robert McCrae (Costa & McCrae, 1992), builds on the tradition of factor analytic approaches to personality definition embodying the work of Gordon Allport, R. E. Christal, J. P. Guilford (Guilford-Zimmerman Temperament Survey) and R. B. Cattell (16 PF). The use of factor analytic approaches in the study of personality is rooted in the wisdom embedded in the lexicon of descriptive adjectives. The Lexical Hypothesis holds that adjectives that have

been used to describe personality are likely to refer to real traits. Moreover, important traits will be described by a greater number of adjectives. Exploratory factor analysis was used to determine a set of distinct, relatively independent dimensions of personality. By beginning with a comprehensive set of adjectives and then examining the clusters that appear to refer to the same characteristics of individuals, i.e., that load on the same underlying factors, the existence of traits can be inferred. The set of adjectives that load on each trait then provide an indication as to how the factor (trait) should be named. John (1990) provides an excellent description of this approach to measuring personality.

Big five refers to the number of factors believed by many researchers to account for a significant portion of personality variance. There is by no means a consensus that there are five factors. Although there are guidelines for interpreting factor analytic solutions, researchers can reach different conclusions even when examining the same data. Cattell concluded that 16 factors are needed to account for the variance in personality (Cattell, 1990). Eysenck (1992) maintains that only three factors are needed. The biologically oriented researchers Zuckerman, Kuhlman, Thornquist, and Kiers (1991) have proposed an alternative five factors. The debate over how many factors are meaningful and how they should be named continues (Zuckerman, 1992; Digman, 1997; Saucier & Goldberg, 1998; Mitchell & Jackson, 2002). It appears to the author, however, that presently the five factors measured by the NEO-PI-R enjoy slightly wider acceptance than alternative formulations.

NEO-PI-R development was guided by both theory and confirmatory factor analysis. Costa and McCrae (1992) constructed items to measure the five factors previously determined through exploratory factor analysis. They then factor analyzed their items and recovered the same five factors. The NEO-PI-R measures the domains of Neuroticism, Extraversion, Openness, Agreeableness, and Conscientiousness. Each domain in turn consists of six facets that relate to different aspects of the domain. The six facets are based on factor analysis of each domain. In the self-report form, eight behaviorally oriented items measure each facet. Items employ a 5-point Likert format. In order to avoid biasing the instrument, statements measuring each facet are split so that half correlate positively with the facet being measured and half correlate negatively. The intended use of the instrument is the prediction of interests, health and illness behavior, psychological well-being, and characteristic coping styles. Studies have also confirmed the incremental validity of the NEO-PI-R over the MMPI-2 in predicting certain deviant behaviors.

4.3.1. Strengths

Reported reliability is excellent. More importantly, research indicates that self-test scores (form S) have correlated highly with ratings by others (form R) (Costa & McCrae, 1992). Research also indicates that the five factors solution accounts for a high percentage of variance in personality. The numbers of adjectives considered in the extensive number of factor analytic studies provide some assurance that most of the factors related to personality have emerged, i.e., that the solution contains a large percentage of personality variance. Overall, it appears that about 70 percent of personality variance can be accounted for by the five factors. The NEO-PI-R also offers a wide range of behavioral associations. Multiple studies relate adjectives to both domains and in some cases, facets. The NEO-PI-R has also been demonstrated across different language groups (universality). The five factors were selected to be orthogonal, are measured on a continuous scale, and have norms available (Costa & McCrae, 1992).

4.3.2. Weaknesses

The five-factor approach is missing an integrating theory that relates traits to behaviors. Traits that are not organized into a behavioral theory can be difficult to use. Research to date has focused on identifying the factors rather than understanding their interplay in producing human behavior. McCrae and Costa (1996) contend, however, that the five-factor approach will provide the basis of a new generation of personality theories. A further weakness is that the factor analytic approach results in traits that are somewhat general and diluted. This outcome is an artifact of the factor analysis process itself. The need to produce a small number of factors necessarily results in broad clusters of somewhat heterogeneous adjectives. As a result, the names of the factors alone do not provide pure traits that suggest how the individual is likely to behave.

4.3.3. Conclusion

The use of the NEO-PI-R as a basis for personality modeling is recommended. It is amenable to ratings by others, provides multiple associations that will be useful in developing behavioral propositions, is comprehensive, and appears to hold across cultures. Further, big five is on the path of much current research. Thus, research results can be used to update personality models in the future.

5. Applying the of NEO-PI-R

The NEO-PI-R can provide a basis for modeling individual personality through the use of the wide range of adjectives that can be generated to describe each

individual. Consider how a complete set of test results may be applied in generating a network of behavioral propositions. The six facets associated with each domain add up to 30 scales that can be used to characterize a person's behavior. Further, research that associates adjectives with facets can be used to compile a list of adjectives that apply to each facet. Costa and McCrae (1992) report adjectives that have been shown to correlate with facet scores. The use of four adjective pairs for each facet provides 120 descriptors that can be used in behavioral modeling. These adjectives can provide a basis for generating behavioral propositions within the area of behavior that the developer wishes to model. Further, propositions can be differentially weighted to reflect the extent to which the associated adjectives correlate with the facet. Altogether this diversity of description can be woven into an extensive rule set network.

Assessment can be obtained in either of two ways. First, if the user knows the person being modeled personally, consideration should be given to obtaining the R form of the NEO-PI-R. The form permits assessment of the 30 facets just as the self-report measure does. In the event that the person to be modeled is not well known, global ratings of the individual may be estimated from descriptions of the five domains. When doing this it is suggested that ratings be pooled in order to increase their reliability. Although domain scores are less useful than facet scores, facet scores can be estimated by taking advantages of reported secondary loadings of facets on domains (Costa & McCrae, 1992).

Research within the modeling community is needed to further develop associations between the big five facets and specific adjectives and behavioral statements useful within different applications.

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