Personality Pinned Down

RAYMOND B. CATTELL

Raymond Cattell, who studied with English and American intelligence researchers, took a mathematical approach to understanding personality. In particular, he used the statistical approach termed "factor analysis" to distill a basic set of dimensions of personality. Factor analysis is a way of reducing or summarizing a large number of correlation coefficients. Cattell's approach was very inductive and data-driven.

Cattell (1905–1998) typically used research designs in which a large number of raters would judge other persons they knew well on a large number of adjectives. Such studies led to what Cattell called "mental factors." Cattell proposed that there are sixteen basic personality traits, which he labeled with letters of the alphabet to be sure that they were objective results of the statistical method, not biased by preconceived notions. In this selection, he describes the Sixteen Personality Factor Questionnaire.

Personality is like love: everyone agrees it exists, but disagrees on what it is. Psychologists have tried to pin down the elusive nature of "personality" in many ways, ranging from the broad intuitive systems of psychoanalysis to the precise but narrow views of behaviorism and learning theory. Still, the substance of personality theory from 1910 to 1960 was Freudian, and novelists and journalists still speak the language of Freud.

In the 1930s, my colleagues and I developed a radical approach to personality based on factor analysis. We discovered that there are certain basic mental factors that can be measured with mathematical precision. Consider the sex drive, presumably an impossible force to quantify (other than "she has a lot of it" or "he has too little of it"). George Kawash and Gerrit De Young used our Motivational Analysis Test to measure the strength of the sex drives of 50 married male graduate students at the University of Illinois. The men rated erotic pictures in terms of how sexually arousing they were. The researchers found that a person's score on our sex drive factor predicted accurately how aroused he would be by the pictures, how much his sex drive would increase after looking at the pictures, and how likely he was to want, or to have, sexual intercourse that evening.

We started our study of personality factors with a conservative goal: to define and measure objectively the basic components of personality before trying to explain, predict, or theorize about them. The history of science demonstrates that breakthroughs always follow this pattern. Isaac Newton pointed out that he could not have tested his theories of motion (forces) if he had not been able to use the exact ways to describe

moving objects developed by Galileo. Similarly, without accurate measurement of personality, it was virtually impossible to choose between, say, two theories concerning the origin and cure of neurosis.

Clinicians vs. Experimenters.   In the 1930s, when we began our work, many experimental psychologists were turning their attention to the study of reflexes, nerve conduction, laws of perception, and laws of rat-learning. But most clinicians chose to ignore the methods of quantitative science. They felt that the experimental psychologists refused to deal with the full complexity of the mind that they encountered in each patient. To the great clinicians, the experimental psychologist must have seemed like a drunkard who knows that his lost wrist watch is out in the alley but searches for it in the house because there is more light inside.

The approach used by experimental psychologists was based typically on a bivariate (meaning "two-variables" or "two-measurements") design. Two groups use the same toothpaste, for example, which varies only in its amount of fluoride. To assess the effect of that one variable, the experimenter looks at a single second variable, the amount of tooth decay.

Such bivariate methods do not work well for studying the mind because mental traits are broad *patterns* of numerous related behaviors, feelings, and responses. Human beings are so complex, and psychological effects so subtle, that trying to get two groups of persons identical in all respects except one becomes unrealistic. It can be done, at best, only in laboratory settings. Bivariate experimental techniques are about as useful for studying personality as forks are for eating soup.

To get around these complex problems, we turned to a mathematical method called factor analysis, which Charles Spearman and Louis L. Thurstone developed in the '20s and '30s. J. P. Guilford used factor analysis in the '50s to find 15 specific ability factors and John L. Horn and I used it to locate two general intelligence factors that account for a person's performance on ability tests [see "Are I.Q. Tests Intelligent?" PT, March 1968].

Factor analysis allows us to look simultaneously at any number and kind of measures and determine how they reduce to patterns. Out of some 100 test responses, for example, we may find nine underlying factors that influence them. It makes no difference whether the variables we start with are repeated measurements of chemicals in one person's blood, or intelligence test scores taken from thousands of persons, or the distribution of traits in a given group.

The Patterns of Personality.   One of our early factor-analysis experiments used check lists of 171 adjectives. We asked our 208 raters to describe other persons they knew well by checking various adjectives—anxious, friendly, dominating, etc. Any individual who tries to describe a particular person in such words might be substantially off base. But we believed that the patterns of use of the adjectives would point to the mental factors which make-up one's "personality." We believed, to paraphrase Lincoln, that you can fool some of the raters all of the time, and all of the raters some of the time, but you can't fool all the raters all the time. Indeed, our factor analysis showed that when the raters describe other persons they often unknowingly evaluate the strength of some 20 underlying personality factors.

We labeled the resulting factors alphabetically, from A to O. We did not assign them descriptive names for years; in the meantime, we established beyond doubt that they were really mental factors, not mathematical artifacts. We slowly became familiar with the intuitive meanings behind the letters and numbers, and we assigned two names to each: one for a high score and another for a low score. We wanted to emphasize that a low score on factor N (forthrightness), for example, indicated the *presence* of something just as an extremely high score on factor N (shrewdness) does. While the verbal names convey meaning to persons unfamiliar with our tests, we prefer the letter designations. Any verbal label gets tied to a complex of everyday meanings and nuances that are different for different persons; moreover, the labels rarely capture the full meaning and content of the factor.

We also wanted to eliminate any possibility that these factors represented some arbitrary but culturally agreed-upon way of speaking about personalities. If we had found *true* mental factors, whatever their psychological meanings, they should appear when we factor-analyzed *any* measures that personality

)0 test re-
aderlying
lifference
ated mea-
od, or in-
f persons,

irly factor-
adjectives.
rsons they
—anxious,
ho tries to
; might be
he patterns
nental fac-
believed, to
of the raters
of the time,
indeed, our
rs describe
valuate the
factors.
nabetically,
otive names
ed beyond
not mathe-
ar with the
imbers, and
high score
emphasize
ss), for ex-
g just as an
ness) does.
persons un-
er designa-
complex of
lifferent for
ely capture

sibility that
it culturally
onalities. If
atever their
ppear when
personality

influences. So next we looked at the way individuals describe themselves.

We asked thousands of persons to answer questions about themselves and again analyzed their responses. We came up with 16 to 20 distinct "introspective" factors; most of them turned out to correspond exactly to the factors that the raters had identified earlier.

The Belated Four.   We were now quite certain that we had found the building blocks of personality. But there were four new factors that the older rating method had not picked up (Q_1, conservative–experimenting; Q_2, group-dependent–self-sufficient; Q_3, uncontrolled–controlled, and Q_4, relaxed–tense). At first we wondered if these were artifacts not really related to personality. But two findings kept us from discarding them. First, they recurred with different persons, different questions, and even with different ways of computing the factors; that is, the new factors were too persistent to ignore. Second, and more important, these factors turned out to have strong correlations with our ultimate validation, real life behavior. For example, persons who score very high on factor Q_4 (tense/driven) tend to be accident-prone, and a high score on factor Q_1 (conservative) or Q_3 (controlled) predicts a tendency to succeed in school. [Editor's note: The sixteen factors are shown in Table 1.]

Apparently, our early belief that the basic personality factors were independent of how they were measured was only partly correct. The four new factors were clearly real, yet undetectable in a factor analysis of raters' descriptions. They were, in a way, the four occasions on which all of the raters were fooled.

Some of the personality traits, as Thomas Klein has shown, are strongly influenced by heredity. One is factor B, general intelligence. Factor C (ego strength), factor F (serious minded–enthusiastic), factor G (superego strength) and factor I (emotional sensitivity) are fairly strongly affected by heredity. Others, such as factor D (calm–excitable), factor E (submissive–dominant), and factor Q (relaxed–tense), are strongly influenced by the way a person is treated in childhood.

A few of the factors are identical to the intuitive concepts that astute clinicians have developed. Factor

TABLE 1   The 16 Personality Factors

A	reserved	outgoing
B	less intelligent	more intelligent
C	affected by feelings	emotionally stable
E	submissive	dominant
F	serious	happy-go-lucky
G	expedient	conscientious
H	timid	venturesome
I	tough-minded	sensitive
L	trusting	suspicious
M	practical	imaginative
N	forthright	shrewd
O	self-assured	apprehensive
Q_1	conservative	experimenting
Q_2	group-dependent	self-sufficient
Q_3	uncontrolled	controlled
Q_4	relaxed	tense

G (expedient–conscientious) corresponds to what Freud called the superego, while factor C corresponds to ego strength. Jung's concept of extraversion/introversion is identical to a "second-order factor"—an influence touching several primary factors—in this case affecting factors A (aloof–warm), F (sober–happy), H (shy–venturesome), and M (practical–imaginative). Factor A is remarkably like the dimension that Ernst Kretschmer described and called "cyclothymia" (warm) on one extreme and "schizothymia" (cold) on the other.

In addition to confirming some clinical concepts, we were able to enlarge upon them. For example, where Jung thought that there were at most four parts to extroversion, our analysis revealed that there are at least five. Further, we found that a true neurotic usually differs from a normal person on five or six personality factors. In particular, neurotics always have a low level of what we call "regression–energy-mobilization." Regression is a lack of psychological energy and a lack of persistence and it includes a tendency to fall back to simple, inadequate, ways of coping.

True and False Neurotics.   By having clinicians diagnose people who have been tested we find that they often diagnose a neurotic person by sensing his high anxiety. As a result they often put the "neurotic"

label on an individual who has high anxiety for reasons not related to any neurosis. He may, for example, be anxious because he has been told that half the employees of his company will be laid off that week. Our regression factor distinguishes persons who have high "situational" anxiety from those who have true neurotic anxiety.

The first general-purpose personality test based on our work is the Sixteen Personality Factor Questionnaire. Its 368 (184 in each of two equivalent forms) multiple-choice questions, selected by factor analysis and not by our subjective choice, measure the level of 16 primary personality factors and eight composite, "secondary," personality factors. This test has very practical, predictive abilities.

For instance, John Nesselroade and I wanted to determine whether "opposites attract" or "like marries like." Some psychologists have proposed that persons with similar temperaments will make compatible marriage partners. Others suggest that persons with different ("complementary") personalities should be more compatible.

We gave our test to two groups of married couples, 100 couples who were stably married, and 80 couples who had come to the counseling center for help with marriage difficulties. We found, basically, that like should marry like if one wants a lasting relationship. Couples in the stable marriages were more likely to have similar personalities than those whose marriages were in trouble.

Several personality factors appear to be especially related to the stability of a marriage: factor A (aloof–warm), factor L (trusting–suspicious), and factor Q (group-dependent–self-sufficient). Persons who are similar in these factors tended to fall in the stably married group. The fourth relevant factor is E (submissive–dominant). Husbands in stable marriages were likely to be more dominant than their wives, but if a husband was *much* more dominant than his wife, that couple generally fell in the unstably married group.

Many researchers have used the Sixteen Personality Factor Questionnaire to explore the relationships between mind and body. A. H. Ismail studied persons in a physical conditioning program and found that exercise is linked with personality changes [see "Jogging the Imagination," PT, March]. A. M. Ostfeld

analyzed the factor scores of nearly 2,000 men between 40 and 55 years old, the age bracket in which most heart attacks occur. Fifty of the men later developed heart disease. Ostefeld found that these 50 men were significantly more likely to be suspicious (factor L), self-sufficient (factor Q_2), and low in superego strength (factor G), than the other men.

The Psychosomatic and Creative Personalities. In fact, there is a distinct psychosomatic profile that is different from the general neurotic's profile. The person who tends to get psychosomatic ailments has considerable ego-strength (factor C) and self-assurance (factor O); most of all, he is cool, reserved (factor A) and unsentimental (factor I). He also has an atypically high level of a second-order factor called cortical alertness. The psychosomatic person seems to have the psychological resources that make him ready to meet and cope with stress, but he acts out the stress internally instead of anxiously withdrawing like a typical neurotic.

The Sixteen Personality Factor Questionnaire also has been used to study creative people. John Drevdahl and I found that the personalities of prominent artists and writers were more similar to each other than to the general population. And despite the fact that we often think of scientists and artists as opposite types, the profile of a group of creative scientists was very similar to that of the artists and writers. The psychological concomitants of creativity are apparently fairly constant, no matter what the person's creative area is. The composite profile of a creative person partly confirms the popular picture of him, or her, as a sometimes tactless, autonomous, nonconformist who does not always work well with a group.

From this and other related studies, we have extracted an equation that roughly estimates any person's creative potential from his personality factor scores. Our work suggests that there is much more to creativity than intelligence. If we wish to study or nurture creativity, or if we want to avoid screening creative persons out of positions because of their sometimes unpleasant personalities, we now have the means to do so.

Getting out of Introspection. There are a number of problems with introspective questionnaires. A person can deliberately or unconsciously distort his

responses, out of the desire to appear in a particular light. While attempts at distortion rarely achieve the effect that the person desires, there are no perfect ways to unscramble the distortion. Another disadvantage of questionnaire tests is that they can be taken only by persons who can read, or at least talk. Many of the questions that personality researchers want to answer concern young children or persons from other cultures with different languages. The fact that a particular question may be interpreted differently by different persons makes any questionnaire test fall short of perfection.

With those drawbacks in mind, and to show that our factors were properties of the mind rather than of the test, we began to design objective measures. Objective tests are a diverse collection of techniques. We define a test as objective if the person being measured cannot tell what aspect of himself is being evaluated, or, if he can, he has no way to change or distort the outcome of the measurement.

Some objective measures are physiological variables, such as heart rate, metabolism, respiration rate, muscle tension, levels of various biochemicals in the blood, or changes in the electrical resistance of the skin. Other objective measures are psychophysical, such as reaction speed or ability to pick spoken words out of a noisy background. Further, we can measure a person's actual behavior, for example while he is working on pencil and paper maze puzzles. We observe his speed, the amount of time he spends hesitating at intersections, and his persistence on mazes that he does not know are insoluble. We can even extract objective measures from pencil and paper tests, such as the Gottschaldt and the Gestalt Closure Test, in which a person tries to identify the subject of an incomplete but definite line drawing. We can measure such variables as the number of correct guesses or the number of threatening objects he claims to see. Clinicians have used such responses to put the person into one of two intuitively defined categories—"synthetic type" or "analytic type." Instead, we throw these measures into the computer for correlation and let the mathematics of factor analysis tell us whether they can be explained by underlying factor types. In the case of the Gestalt Closure Test, they can.

As evidence that our personality factors are true constructs, we factor-analyzed thousands of responses to more than 2,000 objective tests. The results supported our findings from the previous rater and questionnaire tests.

Most of our personality factors have proved stable, so we call them "source traits," emphasizing that they are steady traits and constant sources of behavior. One's level of ego strength or intelligence, for instance, is usually about the same from month to month. However, when change measures are factored, such dimensions as tension, regression, and anxiety are revealed to fluctuate with time and situation. We may think of them as mood or "state" factors. We later found seven other very changeable mood factors, including excitement, general fatigue, and effort stress. These factors, which make for the ups and downs of daily life, appear most distinctly when we factor-analyze physiological measures such as pulse rate, amounts of hormones and nutrients in the blood, amounts of sleep, goodness of memory, and time of day.

Predictions from Personality. In predicting behavior, what state a man is in may be as important as what kind of man he is. But practicing psychologists have plenty to do at present in predicting from traits. Personality factors already permit us to calculate equations that predict many behaviors: academic success, the likelihood of being able to tolerate contact lenses, alcoholism or drug addiction, the volume of a salesman's selling. For example, low G (expediency), high M (imaginativeness) and high E (dominance) each contribute to accident proneness. Our tests can identify neurotic or psychotic persons as well as a good team of psychiatrists can, and they do so more consistently than any one psychiatrist.

Clinicians often treat patients with psychoactive drugs, without knowing which patients will experience unexpected and negative reactions. Gary Forrest, Timothy Bortner and Cornelis Bakker found they could use a test of factor E (submissive–dominant) to predict reactions to the tranquilizer chlorpromazine. Highly dominant persons tend to respond to this drug by becoming agitated.

Until 1960 our factors did not include motivations and drives which are different from general personality

dimensions, and which, we knew, manifest themselves in a person's attitudes and emotions. Thus, the strength of the person's self-assertion drive might appear in his attitudes toward winning arguments, or toward his salary, or toward leading groups.

Two technical advances need to be emphasized. First, we no longer measure motive strength by check list or subjective appraisal. As psychoanalysis has long known, such methods have been shown to be unreliable. Second, we base the decision as to what human drives actually *exist* on multivariate analysis; we do not postulate X number on an armchair basis, as personality theorists have been wont to do. Unfortunately, most laymen, and even many psychologists untrained in multivariate methods, fail to see that the two procedures (nonarbitrary factor analysis and arbitrary speculation) are as different from each other as modern identification of chemical elements is from the air-earth-fire-water system of the alchemists. The labels and the scales may not look very different superficially, but they belong in a new world relative to previous questionnaire scales.

Ergs and Sentiments.   In the realm of dynamic structure factors we soon noticed that we were unearthing two quite distinct kinds of motivational roots:

1) Ergs, which seem to be basic biological drives such as sex, fear (or need for security), parental-prospectiveness, gregariousness, curiosity, self-assertion, and narcissism (self-indulgent sensuality).

2) Sentiments, which are learned drives such as self-sentiment (respect for self-image), career-sentiment, and superego-sentiment (conscience). The sentiments are not distinguishable mathematically from the ergs, but the attitudes that the sentiments affect are directed to cultural objects or events.

Our mathematical analysis showed that each motivation, whether an erg or a sentiment, has two components. One is conscious, and shows up in direct, "inventory" measures of attitudes; the other is unconscious, and shows up in indirect measures, such as word associations, blood pressure, and electrical skin-resistance changes.

Keith Barton, T. E. Dielman and I measured the motivation factors, ability factors and personality factors of 311 sixth- and seventh-grade students. Three

months later the students took Educational Testing Service achievement tests in social science, science, mathematics and reading. We found that our factors were significantly related to the student's achievement in each area. For example, high assertiveness was related to good performance in social studies and reading, but had no relation to performance in science or mathematics. High superego and self-sentiment strengths were positively related to all performances. In contrast, high scores on fear, pugnacity (the hostile-destructive drive), were negatively related to the students' achievement. To our surprise, only the *conscious* component of the motivations affected achievement scores. The unconscious component, if anything, inhibited achievement.

As Freud noted years ago, a person's unconscious motivation can be far different from his conscious motivation. It seemed to us, as to Freud, that such disparities would be a source of psychological conflict. But unlike Freud, we could measure the amount of both components for each motivation factor and get numerical overall conflict scores. In 1959, J. R. Williams measured conflict scores for eight mental hospital patients and found them significantly higher than those of persons from the general population. We may be able to detect mental illness before it develops by measuring a person's conflicts and watching for sudden changes or long-term trends. Similarly, a therapist might be able to use conflict scores to see if a particular technique is working for a particular patient.

Measures of the Mind.   We can formulate equations that demonstrate the role of each motive in any action. This permits us to find out which methods of teaching will reinforce or punish which motives. We have already shown that a freshman college student's first motivation to learn psychology is usually curiosity; but within one semester, curiosity defers to self-assertion and insecurity (fear).

After three decades of learning to catalog and measure the dimensions of the mind, we have the tools to give specific answers to complicated and practical questions. The interrelations of the mental factors we find are extremely complex. They are going to involve more intricate but more exact mathematical predictions than have been envisaged in the incomplete

intuit
truths
precis