Factors are fictions, and other comments on individuality theory

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Abstract

Three of the assumptions in Royce's (1983) theory of personality integration are examined more closely. Royce assumes that: (1) The results from factor analysis are something more than convenient ways to summarize complex covariance structures; (2) it is useful to separate cognitive, affective, sensory, motor, style, and value systems from each other; and (3) it is useful to think of normative "setpoints." These assumptions are challenged and evidence for alternative assumptions is discussed.

Personality Integration: A Synthesis of the Parts and Wholes of Individuality Theory (PI-AS: Royce, 1983) is an abbreviated summary of Royce and Powell's (1983) recent work: *Theory of Personality and Individual Differences: Factors, Systems, and Processes* (TOPID). As such, PI-AS is a synopsis of Royce's lifetime effort to develop a theoretical description of the dimensions, systems, and processes which can be used to describe and understand human personality. The article is necessarily an abbreviated summary of the book and, as such, leaves out most of the supporting evidence found in TOPID. Instead, PI-AS gives the flavor rather than the substance of some very complex propositions. In fact, even TOPID is sketchy and leaves much of the support to earlier works. Thus, any comments on PI-AS must necessarily consider its basic concepts rather than the specific evidence.

In attacking the complexity of personality organization, Royce makes three assumptions that need to be examined more fully. The first is that dimensions derived from factor analysis (or any equivalent multivariate decomposition of a variance-covariance matrix) are useful in psychological theory building for identifying the "structural components of individuality." The second assumption is that it is useful theoretically to divide human functioning into the six "relatively autonomous functional units" of sensory, motor, cognitive, affective, value, and style systems.

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The final assumption is that the "thermostat model" helps us to understand the interaction between an individual and the environment. Although all of these assumptions have heuristic value, their application can lead to serious difficulties.

Factors are Fictions

PI-AS is an organization of six "systems" (e.g., affect, cognitive, etc.) each of which in turn represents the organization of subsystems or "tertiary traits." These third-order factors (e.g., introversion-extraversion) reflect the relations between second-order factors (e.g., social inhibition). The most elemental unit in PI-AS is the first-order factor (e.g., gregariousness). Implicit in this organizational hierarchy is the assumption that such first-order factors represent "invariant dimensions of individuality."

Unfortunately, Royce seems to reify factors and forgets that factors are merely hypothetical abstractions which are estimated from observed patterns of covariances. That factors are frequently used to summarize these same patterns of covariances does not imply that they are more than *convenient fictions*, nor that they should be used to *explain* the patterns. Furthermore, that factors may be arranged hierarchically is a consequence of the method of factor transformation and does not necessarily reflect any underlying hierarchical structure in nature.

It is true that certain factor solutions seem to be replicable across investigators and across studies. But this does not imply that such factors reflect more than the structure of the items or the rotational criterion used. That is, the factors do not have any necessary causal effect on the items. Factors can be merely convenient summaries of relations. Consider the hierarchical organization of the affective system discussed in TOPID and mentioned in PI-AS. The affective type (fourth level) is made up of emotional stability (ES), emotional independence, and introversion-extraversion (I-E) (all of which are called third-order factors). Introversion is seen as a combination of social inhibition and general inhibition (second-order factors) which are, in turn, made up of such first order factors as dominance, self-sufficiency, gregariousness, and surgency. Although this organization is quite typical and has been the basis of a great deal of research (e.g., Eysenck, 1981), there is a considerable controversy as to how these factors relate to the biological dimensions underlying individual differences in affect. Eysenck (1967, 1981) proposes that the fundamental personality dimensions are emotional stability and introversion-extraversion and relates these two dimensions to autonomic activation and cortical arousal. Gray (1972, 1981), on the other hand, has suggested that Eysenck's dimensions of I-E and ES should be rotated to reflect a different set of biological

dimensions: responsivity to reward and to punishment, the latter of which he associates with activity in the septal-hippocampal region. In Gray's scheme, Eysenck's third-order factor of introversion is seen as representing high levels of responsivity to punishment, and low levels of responsivity to reward. If Gray is correct (see also Atkinson, 1974, for a comparable but nonphysiological organization of the behavioral effects of the affective system), then no matter how many times the affective factor pattern is replicated, we are still no closer to the underlying cause of the covariance structure.

The Gray-Eysenck controversy is just one example of how factor analysis can suggest hypotheses but can not resolve issues of causation. Gray and Eysenck do not disagree about the pattern of observed correlations. Rather, they disagree about the meaning of these patterns and the theoretical parsimony of particular factor solutions or transformations. Factor analysis is able to suggest hypothetical structures, but is unable to discriminate between competing latent structures. Even with recent advances in the statistical basis of factor analysis (see Bentler, 1980 for an excellent review) it is only possible to reject a model as being too simplistic rather than to accept a model as being correct. Criteria for simple structure are useful guides to factor replicability, but do not guarantee factor validity. Perhaps the best guide to model acceptability is the goal of minimizing the number of free parameters which need to be estimated. But this does not make any particular factor model correct, merely parsimonious.[1]

Systems Overlap as well as Interact

The second major assumption in PI-AS is that it is possible to partition the "total psychological system" into nonoverlapping systems. Although it is intuitively appealing to talk about sensory, motor, cognitive, affective, style, and value systems as if they were separate, it is a mistake to think that interactions between these systems occur only at the system level or higher rather than at a lower level. But this is a natural consequence of thinking in a hierarchical manner.

Take, for example, the cognitive system. This is said to be "a multidimensional, hierarchically organized subset of information processors

1. Perhaps a more fundamental problem is the assumption of linearity implicit in the use of covariance matrices and in factor analysis. Although a linear model will fit a monotonic function reasonably well, the possibility of nonmonotonic, curvilinear regressions must be considered. Secondly, factor analysis itself is a linear model which is able to detect interactions and curvilinear relations only if the data are suitably transformed. Such transformations (creating new variables to represent higher order powers and cross products of the original variables) make the entire process of exploratory factor analysis hopelessly complex. The implication is that although factor analysis leads to useful summaries of data, it will not necessarily lead to the theoretically best description of the data.

by means of which an organism produces cognitions." This seems to imply that, for the purpose of analysis, we can separate the cognitive system from the sensory or motor systems. But in fact, current thinking in cognition emphasises the constant interplay between sensory stores, long-term associative memories, short-term abstract memories, and motor programs. Broadbent (in press), for instance, has suggested that to understand how information is processed we need to think about the recoding of information from sensory memories into abstract codes, motor codes, and back into sensory codes again before finally observing a motor output. The functioning of such a cognitive system is a constant recoding of information from one form of code to other forms of codes. Studies of "working memory" include visualization, articulatory loops, as well as abstract semantic memory. To separate the cognitive system from the sensory and motor systems is a mistake. The "one way linkage between the cognitive and motor systems" flies in the face of the evidence for articulation and other motor activities as a memory device.[2]

As a further example of the interaction between the lower levels of supposedly different systems, specifically the cognitive and affective systems, consider the effect of impulsivity and caffeine upon cognitive processing. Impulsivity, as one of the components of I-E, is a first- or second-order factor in the affective system. But cognitive performance on a variety of complex and simple reasoning tasks has systematic relations to the interaction of impulsivity and caffeine (Anderson & Revelle, 1982, 1983; Revelle, Humphreys, Simon & Gilliland, 1980; Revelle, Anderson & Humphreys, in press). We have suggested (Humphreys, Revelle, Simon & Gilliland, 1980; Revelle et al., in press) that these effects are due to the relation between arousal (presumably part of the affective system) and information processing resources such as the rate of information transfer and short-term memory (part of the cognitive system). What is most important about these results is that the effects are not mediated through the higher order factors (I-E, ES) of the affective system. The systematic pattern of results are between lower order factors of the affective and cognitive systems.

Perhaps a more compelling model than PI-AS for the relation between sensory and motor control, and affect and cognition can be found in McClean's (1975) discussion of the triune brain. Without benefit of factor analysis, but rather with careful observation and correlation of brain structures to behavior, it is possible to notice three separate, independent brain systems. McClean associates the "reptilian" brain

2. A second problem with the assumption of a hierarchically arranged cognitive system is the evidence suggesting that memory processes are both hierarchical and nonhierarchical. Broadbent (1977) has shown that with the proper experimental manipulations subjects will store information either in a hierarchical or in a nonhierarchical fashion.

stem with automatic life-support functioning, the "paleomammalian" limbic system with affective activity, and the "neomammalian" cortex with cognitive processing. Each system communicates with the others; but their goals are not necessarily the same, and behavior reflects a simultaneous optimization of the needs of the three systems. Although overly simplistic, such a model offers a refreshing alternative to non-overlapping hierarchically structured systems.

Regulation Does not Imply a Setpoint

A common assumption in many discussions of personality and motivation is that behavioral stability in a changing environment reflects the regulatory operation of a homeostatic mechanism. A frequently used analogy is that of a thermostat regulating temperature. For example, discussions of eating regulation in normal and obese individuals include the concept of a "ponderostat" and theories of social interaction and extraversion include the idea of an "arousal-stat." PI-AS continues in this tradition in the "basic system circuit" which includes "a systemic norm against which inputs must be compared." When inputs differ from the norm, behavior is adjusted until the input and norm match (assimilation) or the norm is adjusted to match the inputs (accomodation). The norm is seen as a behavioral thermostat against which inputs are compared. Recent work in control theory (e.g., Toates & Halliday, 1980), however, suggests that such regulation can be achieved without relying upon a comparator or thermostat-like mechanism.

Control systems without comparators achieve stability through simple positive and negative feedback. Eating, for instance, seems to be regulated by the interplay of a satiety mechanism, food taste, and the effort demanded to obtain the food. Satiation is a positive function of eating, eating is a negative function of satiation. Furthermore, eating is increased by improvements in taste and decreased if food availability is contingent upon effort (Bolles, 1980).[3]

Behavioral differences between introverts and extraverts have also been explained using a thermostat analogy. Introverted behavior has been explained with the twin assumptions of an arousal-stat and that introverts are more aroused than are extraverts. Thus, according to Eysenck (1981), introverts seek less stimulation than do extraverts because they are closer to their arousal set point than are extraverts (see also TOPID, p. 127). A control theory explanation, without the use of a set point, suggests that stimulation increases arousal, and that arousal

3. In the fly, eating seems to be controlled only by food availability and negative feedback from the fullness of the gut (a crude satiety mechanism). If the nerve indicating fullness of the gut is cut, flies will eat until they burst (Bolles, 1980).

inhibits stimulation seeking. Introverts differ from extraverts in this model by either having a greater gain in the stimulation-arousal link, or alternatively, greater negative feedback in the arousal-stimulation seeking path. The concept of a setpoint for arousal is not necessary to capture the phenomena.

By avoiding the use of a setpoint, it is possible to include both assimilation and accommodation into the same model. In PI-AS, assimilation involves changing the environment to match the setpoint; accommodation implies changing the setpoint to match the environment. In terms of control theory, however, accommodation can be seen as the effect the environment has upon the individual and assimilation the effect the individual has upon the environment.[4]

Person-situation Interactions

That behavior is not the same from situation to situation is seen by some as a challenge to trait theories of personality. Royce addresses this issue by suggesting that we need to consider the *match* between the demands of a situation and the capabilities of an individual in terms of Royce's six psychological systems. This concept of template matching seems to be an extension of Cattell's (1957) specification equation: The profile of a situation specifies the weights applied to the elements of the (factor) profile of the individual.

An alternative solution would be to consider personality traits as determining the rate of change in response to a situation. In some dynamic models, stable personality traits are associated with the first derivative of states, rather than the state itself. For example, although initially equally aroused, high impulsives seem to become dearoused more rapidly than do less impulsives when faced with a dull recognition memory task (Bowyer, Humphreys, & Revelle, 1983). Similarly, high trait anxiety does not imply that someone is more anxious all of the time, but rather that that individual achieves a high level of state anxiety faster and in more situations than does a less trait anxious person. Stable individual differences in states occur only after prolonged exposure to a constant environment. In a changing environment, stable traits will not lead to constant behavior. If individual differences are associated with rates of change in state from situation to situation rather than with

4. The world's temperature is also regulated without a thermostat. Temperature is a positive function of the solar flux, and a negative function of the amount of heat the earth radiates. Terrestial radiation is a positive function of temperature and a negative function of the amount of carbon dioxide and water vapor in the atmosphere. This system will achieve a steady state when the terrestial radiation matches the amount of energy received from the sun. The earth's temperature can be increased, however, by increasing the amount of carbon dioxide in the atmosphere (Revelle, 1982).

absolute level of a state, then traits will necessarily have interactive rather than additive effects with situations.[5]

The Need for Integration

Personality research has an unfortunate tendency to be fragmented. Personality typologists use factor analysis in an attempt to form a periodic table of personality. Experimental personality research is frequently confined to the investigator's pet dimension; summaries of such research can be ordered alphabetically, but not conceptually (London & Exner, 1978). Introductory texts on personality bear almost no relation to current research, and current research bears little relation to the classic problems of integration and meaning (Brown, 1983).

Although I disagree with the specific method of forming and combining the separate systems, I applaud Royce's attempt at combining what are too frequently seen as unrelated phenomena. It is necessary for those who are concerned with the cognitive components of human behavior to study the affective components, just as it is necessary for those who study the affective components to be aware of the cognitive components. It is most refreshing when factor theorists decide that values, style, and personality integration are important components in their theories.

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5. Atkinson and Birch (1970) have proposed a dynamic model which has been related to achievement-oriented behavior; see Toates and Halliday (1980) for discussions of dynamic models applied to eating, drinking, and mating behavior.

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