Journal of Research in Personality 56 (2015) 70–81

Contents lists available at ScienceDirect

Journal of Research in Personality

journal homepage: www.elsevier.com/locate/jrp

A model for personality at three levels

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ARTICLE INFO

Article history:
Available online 16 April 2015

Keywords:
Personality traits
Dynamics of action
Reinforcement sensitivity theory
Multi level model
Affect
Behavior
Cognition
Desire
Motivation
Goals

ABSTRACT

People differ. How and why they differ are the fundamental questions for personality psychologists. In this article we address three levels at which people differ: within individuals, between individuals, and between groups of individuals. A dynamic model of personality is considered where traits are seen as rates of change in states in response to environmental cues. Within individuals, motivational and behavioral states show inertial properties and lead to an analysis of rates of change and latencies of behavior. Between individuals, the analysis is one of frequency and duration of choices. When individuals self select into groups reflecting shared interests and abilities, the structure of these group differences reflects the consequences of the self selection. Examples of the dynamic model are given for each level of analysis.

1. Levels of individual differences

People differ. How and why they differ are the fundamental questions for personality psychologists. In this article we address three levels at which people differ: within individuals, between individuals, and between groups of individuals. Although the structure of differences at each level do not necessarily relate to the structure of differences at other levels, analysis of the temporal dynamics of differences suggests some hope for a unified model. The study of temporal dynamics in personality is not new (e.g., Atkinson & Birch, 1970; Carver, 1979; Carver & Scheier, 1982; Kuhl & Blankenship, 1979; Read et al., 2010; Revelle & Michaels, 1976; Revelle, 1986, chap. 7) but, with few exceptions (Carver, 1979; Carver & Scheier, 1982; Read et al., 2010), has not had much impact upon personality theory, perhaps because a disproportionate amount of research has focused on the identification of interindividual personality structure rather than dynamics (Read et al., 2010). This is unfortunate, for the study of dynamics integrates aspects of choice, persistence, latency, frequency and time spent into a common framework. As we will show, by understanding temporal dynamics *within* people, we are able to explain patterns of choice *between* people and, by examining the cumulative effect of these choices in terms of time spent, to understand the ways in which individuals tend to *organize into groups* according to personality traits.

Personality is an abstraction used to describe and explain the coherent patterning over time and space of affects, cognitions, desires and the resulting behaviors that an individual experiences and expresses. People differ from themselves on a moment to moment basis in that they do not think, feel or act the same all the time. They change in their feelings, in their thoughts, in their desires and in their actions. To not change in response to a situation is maladaptive. When others evaluate our reputation, they are evaluating our behavior in critical situations and how it changes across situations. When we think of our identity, we interpret our behavior as the result of our affects and our cognitions.

A primary level of analysis of personality examines the patterning of ways in which people change. To observers, the dynamic stream of feelings, thoughts, motives and behavior show a unique temporal signature for each individual. To an individual differences theorist, the issues of how and why individuals differ in their patterns are central to the domain of study (Costa & McCrae, 1992a; Digman, 1990, 1997; Eysenck, 1981; Eysenck & Himmelweit, 1947; Goldberg, 1990; Hogan, 1982; Hogan & Kaiser, 2005). To a biologically minded psychologist, these dynamic processes reflect genetic bases of biological sensitivities to the reinforcement contingencies of the environment (Corr, 2008a; Corr, DeYoung, & McNaughton, 2013; DeYoung et al., 2010; Smillie, 2008; Smillie, Cooper, Wilt, & Revelle, 2012; Smillie, Geaney, Wilt, Cooper, &

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[1] Preparation of this manuscript was funded in part by Grant SMA-1419324 from the National Science Foundation to WR. We would like to thank Colin DeYoung, Steven Read, and two anonymous reviewers for very helpful comments on a previous version of this manuscript.

http://dx.doi.org/10.1016/j.jrp.2014.12.006
0092-6566/

Revelle, 2013). To a mathematically oriented psychologist, these dynamic processes may be modeled in terms of the differential equations of the Dynamics of Action (Atkinson & Birch, 1970; Atkinson & Raynor, 1974; Revelle, 1986, chap. 7).

Read and Miller and their colleagues (Read, Vanman, & Miller, 1997; Read et al., 2010) have pointed out that most who study the dynamics of personality within individuals tend not to be concerned with between individual structure, and vice versa. They (Read et al., 2010) have presented a neural network model that attempts to integrate dynamics and structure. The "Cybernetic Big Five Theory" proposed by DeYoung (2015) is an alternative (although less explicit) dynamic model which attempts to explain personality structure in terms of dynamic processes. Here we present a somewhat different formal model of dynamics that has similar goals to these other researchers.

By examining patterns of change *within individuals*, it is possible to organize the study of personality at a second level – that is, the analysis of the structure of differences *between individuals* in the coherent patterning over time and space within individuals. It is at this level that conventional trait theorists describe how people differ from each other in the frequency distribution of their actions (Fleeson, 2004, 2007a). Differences in sensitivity to the rewarding or punishing aspects of the environment are discussed at this level in terms such as *reinforcement sensitivity* (Corr, 2008a; Corr et al., 2013; Gray & McNaughton, 2000; Smillie, 2008; Smillie, Loxton, & Avery, 2011, chap. 4). We model differences at this level in terms of the rates of change in response to situational inputs and how these differences in rates of change result in differences in frequency and duration of various feelings, thoughts, and actions.

People also differ from each other in terms of important life choices; examples include choice of college major and career. As we will show, these choices reflect a dynamic interplay of abilities, interests, and temperament in response to the long term patterns of reinforcements achieved by each individual. These patterns of reinforcement, in combination with original differences in sensitivities to environmental cues can result in group differences that are structured in a completely different manner than the structure of personality normally seen at the interindividual level.

1.1. Different levels can be different

Before elaborating on the three levels introduced above, it is important to acknowledge that each of the levels may differ dramatically in both content and structure. Although it is well known that the structure within one level does not imply anything about the structure at a different level, this distinction is frequently forgotten. Indeed, Cattell (1943, 1946) (see Revelle, 2009) went so far as to suggest that the dimensions within individuals should be the same as those between individuals. That analyses at different levels should not be confused has been labeled the Yule–Simpson paradox (Armistead, 2014; Kievit, Frankenhuis, Waldorp, & Borsboom, 2013; Pearl, 2014; Simpson, 1951; Yule, 1903), the fallacy of ecological correlations (Robinson, 1950) and the within group–between group problem (Pedhazur, 1997). Indeed, to confuse the dynamics within individuals with the averages between individuals is to mistakenly assume ergodicity (Molenaar, 2004). A very clear exposition of the problem is found in Kievit et al. (2013).

This has not been a serious problem until recently, because much of traditional personality research ignored within subject variation and has examined the structure between individuals based upon self report inventories reflecting one's average level of feeling, thoughts, and behavior. But with recent developments in real time data collection (e.g., Electronically Activated Recordings (Mehl, Gosling, & Pennebaker, 2006; Mehl, Vazire, Holleran, & Clark, 2010), paper or electronic diary studies (Green, Rafaeli, Bolger, Shrout, & Reis, 2006; Rafaeli, Rogers, & Revelle, 2007) or cell phone based measures of activity (Wilt, Condon, & Revelle, 2011a, chap. 10; Wilt, Funkhouser, & Revelle, 2011b)) in combination with improved understanding of multi-level modeling (Bliese, Chan, & Ployhart, 2007; Fleeson, 2007a; West, Ryu, Kwok, & Cham, 2011) it is now possible to study the individual patterns of dynamics within individuals and relate these patterns to differences between individuals.

In a multilevel structure, observed correlations across individuals (r_{xy}) may be decomposed into within individual correlations ($r_{xy_{wp}}$) and between individual correlations ($r_{xy_{bp}}$). Similarly, the correlations between individuals when individuals are members of different groups reflects this within and between group correlational structure. As a simple example, consider the correlation between cognitive ability and alcohol consumption. Within individuals, the correlation is negative (alcohol consumption reduces cognitive performance) but between individuals, those with higher cognitive ability consume more alcohol (Batty et al., 2008). At any one occasion, the overall correlation between alcohol consumption and cognitive performance (r_{xy}) will reflect an unknown mixture of these two quite different correlations ($r_{xy_{wp}}$ and $r_{xy_{bp}}$). It is possible to decompose the correlation between two variables such as these into the between and within person correlations using the following, straight-forward formula (adapted from Pedhazur, 1997):

$$r_{xy} = \eta_{x_{wp}} * \eta_{y_{wp}} * r_{xy_{wp}} + \eta_{x_{bp}} * \eta_{y_{bp}} * r_{xy_{bp}}$$

where $r_{xy_{wp}}$ is the within person correlation, $r_{xy_{bp}}$ is the between person correlation, $\eta_{x_{wp}}$ is correlation of the data with the within person values, and $\eta_{x_{bp}}$ is correlation of the data with the between person values.

This distinction between correlations at different levels is a fundamental part of multilevel modeling and will be important as we consider models of coherency and differences within-individuals, between-individuals, and between groups of individuals. That correlations may differ across levels does not imply that they always will, but the assumption that they do not vary (that they are ergodic) is one that should be tested rather than merely assumed.

2. Dynamics within individuals

Dynamic models imply more than the mere observation that people differ over time for this could just be random fluctuations around a mean level. Rather, the basic concept of individual dynamics is that time is a variable which needs to be modeled. One way to distinguish patterning over time from random variation around a mean level is to examine the *mean square successive difference* (mssd, von Neumann, Kent, Bellinson, & Hart, 1941) which effectively is a (negative) index of the trial to trial autocorrelation. A small mssd in comparison to the variance implies that although behavior may vary across trials, it does not vary much from one trial to the next.

Inspired by the work of Lewin, Adams, and Zener (1935), Zeigarnik (1927/1967), Feather (1961); and Atkinson and Cartwright (1964), the proposition that motivation and action have inertial properties was added by Atkinson and Birch (1970). That is, they proposed that a wish persists until satisfied and a wish does not increase unless instigated. (This is, of course, analogous to Newton's 1st law of motion that a body at rest will remain at rest, a body in motion will remain in motion.) By considering motivations and actions to have inertial properties, it became possible to model the onset, duration, and offset of activities in terms of a simple set of differential equations.