Personality and Individual Differences 103 (2016) 61–67

Contents lists available at ScienceDirect

Personality and Individual Differences

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

Traits, cognitive processes and adaptation: An elegy for Hans Eysenck's personality theory

Gerald Matthews

Institute for Simulation & Training, University of Central Florida, 3100 Technology Pkwy, Orlando, FL 32826, USA

ARTICLE INFO

Article history:
Received 11 December 2015
Accepted 6 April 2016

Keywords:
Personality traits
Extraversion
Neuroticism
Arousal
Cognitive models

ABSTRACT

Hans Eysenck's personality theory has inspired several generations of researchers. However, it has substantial limitations as an account of the individual differences in performance and cognitive processing associated with personality traits. Three particular areas of concern are its handling of the complexity of processing, its attribution of performance effects to variation in cortical arousal, and its neglect of the adaptive significance of traits. The neurological concomitants of traits may be more consequential as indirect influences on skill acquisition than as direct influences on adaptation. Cognitive-adaptive theory provides a contrary perspective that sees traits as distributed across multiple processes and accommodates the dynamic nature of individual differences in adaptation. It may be time to laud the Eysenck theory for its historical contribution and lay it to rest with due respect.

1. Introduction

Hans Eysenck was a shadowy but insistent presence during my Ph.D. studies at Cambridge in the early 1980s. My supervisor, Carl Sargent, actually knew Hans through their 1994 book on *Explaining the Unexplained* but I did not meet Professor Eysenck in person until much later at a meeting of the *International Society for the Study of Individual Differences* (ISSID). I read his works on personality assiduously, but with increasing scepticism fueled both by my own findings and my interest in cognitive psychology. Luminaries of the Cambridge Applied Psychology Unit including Alan Baddeley and Tim Shallice were influential in this regard. In the personality field, I took more inspiration from the contemporaneous works of Michael Eysenck and William Revelle.

My first direct contact with Hans Eysenck, though I did not realize it at the time, was through his review of an article based on my Ph.D. work, submitted to *British Journal of Psychology* (Matthews, 1985). The study concerned tested whether extraversion effects on intelligence test performance were mediated by self-report arousal, and I concluded that arousal was a moderator not a mediator, contrary to the Eysenck theory. My paper was not very well-written, as the journal reviewers duly noted, and it would have been easy to reject. However, despite my over-enthusiastic criticism of his theory, Eysenck generously gave the submission a second chance (the word 'salvage' was used). The reviews were anonymous but I learnt later on of Eysenck's role, for which I was grateful. Subsequently he invited me to review for PAID, and I came to appreciate his philosophy of allowing authors to tell their own story so long as the study was rigorously conducted (I have at times wished other editors took a similar view).

In my first faculty positions I strived to establish myself as a critic of Eysenck and an advocate for cognitive-psychological perspectives on traits. So, I was surprised when he invited me to write a review for PAID (Matthews & Gilliland, 1999) that would evaluate the evidence for his theory, along with its then main competitor theory advanced by Jeffrey Gray. A fortuitous sabbatical at the University of Oklahoma furnished me with a collaborator with more expertise in psychophysiology than I, Kirby Gilliland, a former student of Bill Revelle. The review was no easy task, not least because of the conflicting nature of much of the evidence. To our sorrow, Eysenck died before it was completed, so we never received his opinions on it. There followed a tragicomic episode in which the then editor of PAID, on receiving a 27,000 word manuscript out of the blue, expressed notable reluctance to have anything to do with it, along with scepticism that Eysenck had ever commissioned anything of this kind. Fortunately, I was able to find Eysenck's invitation letter to me.

Matthews and Gilliland (1999) arrived at four possible evaluations of the Eysenck theory, based on the mixed outcomes of psychophysiological and behavioural tests of predictions. A reasonable person might (1) wait for evidence from more advanced psychophysiological techniques for definitive theory-testing, (2) require a more sophisticated neurological theory perhaps integrating elements from Gray and Eysenck, (3) place cognitive constructs as mediating variables between neural and behavioural ones, or (4) fundamentally re-evaluate the role of individual differences in brain functioning in order to accommodate cognitive variation. A contemporary review would likely arrive at the same options; my preference remains (4).

E-mail address: gmatthews@ist.ucf.edu.

http://dx.doi.org/10.1016/j.paid.2016.04.037

My purpose in this article is not to update the Matthews and Gilliland (1999) review, but rather to evaluate Eysenck's general approach to personality theory-building from a cognitive science standpoint. To avoid repetitive citation I will address Eysenck's arousal theory as set out in Eysenck (1967, 1981, Eysenck & Eysenck, 1985). I will also briefly describe some features of my own cognitive-adaptive theory of traits as a contrary perspective (Matthews, 1999, Matthews, 2008a, b, 2009, submitted).

2. Key features of the Eysenck personality theory

Eysenck's theory provides a model of what a personality theory might look like. Its assumptions are also common to other influential psychobiological theories, especially Reinforcement Sensitivity Theory (RST: Corr, 2009; Corr & McNaughton, 2012). I will examine how well this meta-theory holds up, in the context of human performance research, rather than examine the predictive successes and failures of the theory in detail. I will not reiterate the theory here, but the following features are the most relevant.

1. The conceptual nervous system (CNS) defines explanatory constructs. A key assumption is that theory can work with a much-simplified account of brain functioning that defines major systems, without necessarily specifying neural structures and processes in fine detail. In Eysenck's account, the main systems are a cortico-reticular circuit, linked to alertness and to extraversion, and a cortico-limbic circuit, linked to emotion and neuroticism. The third factor of psychoticism has been linked both to circuits for fight-flight behaviour and to excessive production of dopamine (Corr, 2010).
2. The elements of the CNS directly control individual differences in performance. Thus, a prerequisite for interpreting personality differences in performance is an additional theory that links CNS constructs to information-processing. Eysenck most commonly referred to traditional arousal theory and the Yerkes–Dodson Law (see Matthews, Davies, Westerman, & Stammers, 2000a). He would most likely have welcomed more recent approaches that attempt to differentiate different roles for the different neurotransmitters that may modulate attention (e.g., Noudoost & Moore, 2011).
3. Individual differences in performance and learning are consequential for real-world adaptation. Arousal theory is said to explain the influence of traits on outcomes such as health, mental illness, social functioning, criminal behaviour and work preferences and success (Furnham & Heaven, 1999). Eysenck's account of personality emphasized the interactive of traits with situational modifiers. Introverts are over-aroused by general levels of stimulation, neurotic individuals by emotive stimuli. Thus, adaptation is expressed in terms of match between personality and environments. Introverts will exhibit poorer outcomes in stimulating environments such as social encounters and demanding work environments, while neurotics will be prone to emotional disorders when exposed to stressors.

Next, I will consider these three features in more detail. For each, I will list several key challenges which, at the least, call for a response from psychobiological theorists, and at the most threaten the validity or utility of the Eysenck theory.

3. Theoretical utility of the conceptual nervous system

Matthews and Gilliland (1999) reviewed the support provided by psychophysiological studies for the basic tenets of Eysenck's theory, which amount to tests of whether personality predicts tonic arousal and arousal response as the theory predicts. Outcomes were mixed and paradigm-specific. A review including contemporary research would probably arrive at a similar conclusion. Some authors see evidence for the theory as continuing to accumulate (e.g., Stelmack & Rammsayer, 2008) but there remain troubling failures to confirm predictions. For example, Korjus et al. (2015) collected electroencephalographic (EEG) data from 289 participants, but even the application of machine-learning algorithms failed to establish any relationship between the Big Five traits and EEG. In fact, the majority of contemporary psychophysiological studies are inspired more by RST (Corr, 2009), which emphasizes links between traits and brain systems for motivation, such as the hypothesized dependency of extraversion on a dopaminergic reward system. Again, there are instances of empirical support (De Pascalis, 2008), but a recent review (Wacker & Smillie, 2015) concludes that “clear links between extraversion and dopamine-related genes and brain structures remain elusive” (p. 230). In a review of brain-imaging studies, Kennis, Rademaker and Geuze (2013, p. 91) reported: “Correlations between personality and brain activation were often found to be both positive and negative.”

There may be a variety of reasons for failures to confirm predictions from psychobiological theory in psychophysiological studies, including a range of methodological issues (Corr, 2001; Kennis et al., 2013; Wacker & Smillie, 2015). Here, I want to explore some more fundamental, conceptual challenges to Eysenck's theoretical worldview.

3.1. Brain complexity

The complexity of both neural and psychological processes encourages fractionation and ever-finer specialization. Like Eysenck, nomothetic personality psychologists must stand against this tide and assert the explanatory power of broad-based traits. However, there is a fine line between abstracting key features of brain functioning in the interests of problem tractability, and becoming too simplistic to support effective prediction. Cortical arousal plays a central explanatory role in Eysenck's theory, but it may not be an adequate index of functional brain processes. Even within the studies shaped by the theory there seem to be distinct sets of cortico-reticular and dopaminergic correlates of extraversion (Matthews & Gilliland, 1999), and brain-imaging studies suggest a still-more differentiated set of neural correlates (Kennis et al., 2013).

According to Eysenck, the cortico-reticular loop supports alertness, a proposition that can be tested in studies of personality and vigilance (Finomore, Matthews, & Warm, 2009). However, brain-imaging data suggest that vigilance is controlled by multiple, predominantly right-brain, structures that regulate a complex interaction between top-down, goal-directed attention, and bottom-up, stimulus-driven prioritization of inputs (Langner & Eickhoff, 2013). These processes may influence classic arousal responses, but working backwards from observations of arousal response to inferences about functioning of specific brain areas is hazardous indeed. From a human performance standpoint, the explanatory power of arousal as a causal construct is in any case questionable (Hancock & Matthews, 2015; Matthews et al., 2000a).

Rather, in Langner and Eickhoff's (2013) conception, different brain systems support different functions, such as maintaining S-R mappings (inferior frontal junction), signalling attentional priority (intraparietal sulcus) and selective biasing and filtering (midlateral prefrontal cortex). Eysenck's theory links extraversion–introversion to vigilance, but predictions from the theory are only weakly confirmed at best (Finomore et al., 2009; Koelega, 1992). Determining extravert–introvert differences in more narrowly defined brain processes may be a more productive research strategy than further tests of arousal theory.

3.2. Arousal response complexity

The complexity of the brain is mirrored by the complexity of physiological indicators. Large scale studies of autonomic and central nervous system arousal metrics do not suggest any general factor corresponding to arousal or mental effort (Fahrenberg, Walschburger, Foerster, Myrtek, & Müller, 1983; Matthews & Amelang, 1993; Matthews, Reinerman-Jones, Barber, & Abich, 2015). Indeed, psychophysiological responses may be more useful when more narrowly interpreted in