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Biological Basis of Personality: A Brief Review

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ABSTRACT: This brief review discusses the research on biology-based personality and personality theories with biological basis. These theories include Eysenck's three factor model of personality, Gray's reinforcement sensitivity theory, and Cloninger's model of personality. The biology-based personality research is a relatively new topic in the field of psychology and there is a lot of scope for further research in the future specially in the field of neuroscience. Although it is a relatively new topic, but growing in interest and number of publications. Only recently in August 2004, there was a conference specifically on this topic, called "The Biological Basis of Personality and Individual Differences". This was a good forum for presenting and sharing of ideas between psychologists, psychiatrists, molecular geneticists, and neuroscientists. Recently it was named as the field of 'Personality. Therefore, further research on the biological basis of personality, especially in the field of 'Personality Neuroscience' is recommended.
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INTRODUCTION

Biological Basis of Personality

Personality is derived from the Latin word, persona, where it originally referred to a theatrical mask [1]. The study of personality started with Hippocrates' four humors and gave rise to four temperaments [2]. Personality is the dynamic organization within the individual of those psychophysical systems that determine his characteristics behavior and thought [3]. Weinberg and Gould [4] defined personality as the characteristics or blend of characteristics that make a person unique. The American Psychological Association defines personality as individual differences in characteristic patterns of thinking, feeling, and behaving [5].

The study of personality focuses on two broad areas: [1] understanding individual differences in particular personality characteristics, such as sociability or irritability and [2] understanding how the various parts of a person come together as a whole [5].

Biological Basis of Personality

The biological perspective on personality emphasizes the internal physiological and genetic factors that influence personality. It focuses on why or how personality traits manifest through biology and investigates the links between personality, DNA, and processes in the brain. It is primarily accomplished through correlating personality traits with scientific data from experimental methods such as brain imaging and molecular genetics [6].

The biological basis of personality is the theory which states that the anatomical structures located in the brain contribute to personality traits. This is derived from neuropsychology, a branch of science which studies how structure of the brain is related to various psychological processes and behaviors. For instance, in human beings, the frontal lobes are responsible for foresight and anticipation, and the occipital lobes are responsible for processing visual information. In addition, certain physiological functions such as hormone secretion also affect personality. For example, the hormone testosterone is important for sociability, affectivity, aggressiveness, and sexuality [7]. Other studies also show that the expression of a personality trait depends on the volume of the brain cortex it is associated with [8].

Personality neuroscience involves the use of neuroscience methods to study individual differences in behavior, motivation, emotion, and cognition. Personality psychology has contributed much to identifying the important dimensions of personality, but relatively little to understanding the biological sources of those dimensions. However, the rapidly expanding field of personality neuroscience is increasingly shedding light on this topic. DeYoung [8] provided a survey of progress in the use of neuroscience to study personality traits, based

on the Big Five dimensions: extraversion, neuroticism, agreeableness, conscientiousness, and openness or intellect.

The biological approach to personality has also identified areas and pathways within the brain that are associated with the development of personality. A number of theorists, such as Hans Eysenck, Gordon Allport, and Raymond Cattell, believe that personality traits can be traced back to brain structures and neural mechanisms, such as dopamine and serotonin pathways [6]. One of the best known biological theorists was Hans Eysenck, who linked aspects of personality to biological processes. Eysenck argued that introverts had high cortical arousal, leading them to avoid stimulation. On the other hand, he believed that extroverts had low cortical arousal, causing them to seek out stimulating experiences [9].

The emphasis is placed on the biochemistry of the behavioral systems of reward, motivation, and punishment. This has led to a few biologically based personality theories such as Eysenck's three factor model of personality, Grey's reinforcement sensitivity theory, and Cloninger's model of personality. The Big Five model of personality is not biologically based, but still some studies provided biological support for this model [10]. The most influential scientists in the field of biology-based personality theories are Hans Eysenck and Jeffrey Alan Gray. Eysenck used both behavioral and psychophysiological methodologies to test and develop his theories [11].

History of Biology-based Personality Research

It has been, since the ancient Greek time, attempted to explain personality through spiritual beliefs, philosophy, and psychology. Historically, studies of personality have traditionally come from the social sciences and humanities, but in the past two decades neuroscience has begun to be more influential in the understanding of human personality [12]. Eysenck published a book called "Dimensions of Personality," describing the personality dimensions of extraversion and neuroticism. He has many publications in this field [13-18]. Gray, his student, studied personality traits as individual differences in sensitivity to rewarding and punishing stimuli [11]. The significance of Gray's work and theories was the use of biology to define behavior, which stimulated a lot of subsequent research [19].

The biology-based personality research is a relatively new topic and recently, in 2004, there was a conference entitled "The Biological Basis of Personality and Individual Differences". This resulted in the publication of a book "The Biological Basis of Personality and Individual Differences" [20].

Personality Theories with Biological Basis

The following theories of personality have a biological basis. It will provide, in addition, a biological support for a popular non-biologically based personality theory, the Five Factor Model.

Eysenck's Three Factor Model of Personality: It was based on activation of reticular formation and limbic system in the brain [21]. The reticular formation is a region in the brainstem that is involved in mediating arousal and consciousness. The limbic system is involved in mediating emotion, behavior, motivation, and long-term memory. The three factors are extraversion (interaction with people), neuroticism (emotional instability), and psychotism (aggression and interpersonal hostility) [11].

Gray's Reinforcement Sensitivity Theory: This theory is based on the idea that there are three brain systems that all differently respond to rewarding and punishing stimuli [11]. These are (a) fight-flight-freeze system which mediates the emotion of fear (not anxiety) and active avoidance of dangerous situations. The personality traits associated with this system is fear-proneness and avoidance; (b) behavioral inhibition system which mediates the emotion of anxiety and cautious risk-assessment behavior when entering dangerous situations due to conflicting goals. The personality traits associated with this system is worry-proneness and anxiety; and (c) behavioral approach system which mediates the emotion of anticipatory pleasure, resulting from reactions to desirable stimuli. The personality traits associated with this system are optimism, reward-orientation, and impulsivity [11].

Cloninger Model of Personality: It is based on the idea that different responses to punishing, rewarding, and novel stimuli are caused by interaction of three dimensions: (a) novelty seeking which deals with the impulsiveness of people and is correlated with low dopamine activity; (b) harm avoidance which deals with the anxiousness of people and is correlated with high serotonin activity; and (c) reward dependence which deals with the approval seeking of people and is correlated with low norepinephrine activity (20).

Five Factor Model of Personality: It describes five core traits that a person possesses: (a) openness (enjoyment after experiencing new stimuli); (b) conscientiousness (dutiful and goal-oriented); (c) extraversion (people who seek stimuli outside of themselves); (d) agreeableness (aim to cooperate and please others); and (e) neuroticism (people who are emotionally unstable) [10; 22].

Hegerl et al. [23] in an article entitled “Sensory cortical processing and the biological basis of personality” concluded that their results support the concept that the serotonergic brain system, which is supposed to modulate sensory processing in primary auditory cortices, is an important factor underlying individual differences in sensation seeking. Action-oriented personality traits such as sensation seeking, extraversion, and impulsivity have been related to a pronounced amplitude increase of auditory evoked scalp potentials with increasing stimulus intensity [23]. The biological approach to personality has also identified areas and pathways within the brain, as well as various hormones and neurotransmitters, that are associated with the development of personality [6].

CONCLUSION AND RECOMMENDATIONS

As mentioned earlier, the biology-based personality research is a relatively new topic in the field of psychology and there is a lot of scope for further research in the future specially in the field of neuroscience. Although it is a relatively new topic, but growing in interest and number of publications. Only recently in August 2004, there was a conference specifically on this topic, called “The Biological Basis of Personality and Individual Differences”. This was a good forum for presenting and sharing of ideas between psychologists, psychiatrists, molecular geneticists, and neuroscientists. A book entitled “The Biological Basis of Personality and Individual Differences” was later on published [22]. Recently, DeYoung has gone further to name it as the field of 'Personality Neuroscience' [8].

Therefore, further research on the biological basis of personality, especially in the field of 'Personality Neuroscience' is recommended.

Competing interests

The authors declare that they have no competing interests.

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