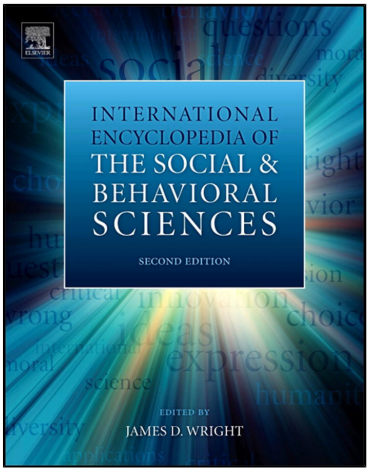

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Personality, Biological Models of

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Abstract

Personality theories attempt to describe systematic differences between people in affect, cognition, and behavior, across situations and over time. Some theories attempt also to explain the causal roots of these individual differences, and biologically oriented ones focus on genetic and neurophysiological processes that underlie fundamental emotion and motivation processes. Approach-avoidance personality theories have dominated this literature: These are summarized along with the relevance of genetic and neuroimaging research methodologies. Conceptual issues in personality psychology are discussed to show how biologically oriented theories relate to other theoretical perspectives (e.g., social and psychometric).

Theories of personality aim to describe systematic differences between people in affect, cognition, and behavior, across situations and over time. A second major aim is to account for the causal roots of these individual differences, either in social, psychological, or neurological terms. Biological models of personality are specifically concerned with explaining the genetic and neurophysiological bases of these differences.

The phenomena of interest to the personality psychologist include both person and environmental factors, and their interactions. For this reason, there is a need to recognize multiple levels of analyses. Therefore, in a strict scientific sense, there cannot exist purely 'biological' or 'social' theories of personality. What 'prefix' theories of personality can claim to achieve is to emphasize the relative role played by a specific level of explanation. However, in order for any such theory to relate to personality factors (descriptions) and processes (causes), it cannot escape the fact that it is part of a broader conceptual framework. For example, the vast majority of personality theories start with a statistical description of systematic differences between people, typically relying upon psychometric principles and questionnaires (or some other form of self/other report). Data from these forms of measurement are neither purely 'biological' nor 'social' but entail 'method variance.' From a specific theoretical perspective, although such variance may be considered 'nuisance,' it is nonetheless real and reflects the multitude of influences on all forms of personality description. In addition, self/other ratings are about something (e.g., openness to experience of *what*?): From the respondent's point of view, test items are imbued with meaning. These observations do not undermine the attempt to construct a scientific theory of personality, but they do complicate matters and render single-level explanations problematic in terms of offering a comprehensive description and explanation of personality.

Once these complexities are recognized, it is possible to develop a 'social' theory of personality that emphasizes the relative effects of environmental factors, although such theories encounter significant problems in accounting for the full range of variation observed between people when tested in identical environments. In the case of a 'biological' theory of personality, it is simply not possible to ignore the role of the environment and broader social context: Biological effects are shaped by and expressed through the environment. In this strict sense, there cannot exist a purely 'biological' model of personality.

Far from being a counsel of despair, the above considerations highlight the important issues that need taking into account in understanding the biological approach to personality.

Surface Traits and Source Processes

In any personality theory, especially biological ones that lay stress upon underlying causal factors, there is an important distinction between two major levels of explanation: Surface traits and source processes.

In everyday life, it is typical to describe people's personalities in lexical terms. For example, we may describe John's characteristic ways of thinking, feeling, and behaving as 'smart,' 'fearful,' and 'cautious,' and these adjectives are readily understood and serve as a convenient means of communication, especially when they have an evaluative component (e.g., 'lazy,' 'ambitious,' 'aggressive'). We also talk about people's expected future behavior in the same manner; for example, John is 'trustworthy' and a 'regular' guy, and this allows us to predict the likely reaction of John to a range of situations.

Research personality psychologists have adopted essentially the same approach to describing personality, although their descriptions are couched in statistical terms. There is a long tradition of analyzing the ratings of a large number of trait adjectives to produce descriptive taxonomies, the most popular being the Big Five: Extraversion, Neuroticism, Conscientiousness, Agreeableness, and Openness to Experience/Intellect. Meta-analyses agree that these Big Five dimensions emerge from many existing personality questionnaires not designed specifically to measure them (e.g., Markon et al., 2005). These five dimensions describe systematic individual differences at the population level, and they are typically called 'traits' (or more generally, 'factors').

As a 'surface' level description of variation at the population level, the Big Five does a good (but not uncontested) job. But it should be obvious that statistical description at this high level of abstraction is bound to be influenced by a broad range of factors, ranging from biological (DNA) to societal. There are also likely to be significant cross-cultural differences in the formation and expression of these traits.

What the Big Five and other population-wide statistical descriptions of personality do not readily provide is information regarding the causal 'sources' of these surface traits: Scientific

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explanation is about explaining, not just naming. What we observe at this surface level of description is the end product of a chain of interacting processes, and we can have little confidence in the assumption that these interactions are not complex. Since at least the time of Sir Francis Bacon, it is appreciated in science that it is difficult, sometimes seemingly impossible, to infer causes from observed effects. This is a major problem in personality psychology. To cut this Gordian knot, it is necessary to propose causal theories of underlying processes. Biological theories have been central in this scientific enterprise.

One important question that cries out for an answer is why do people feel, think, and act in the ways they do? One model is to assume that the environment (or situation) determines behavior, and that a history of reinforcement shapes individual propensities to respond to situations in specific ways. This behaviorist account has fallen out of favor for several reasons. First, it is tautological and circular in argument, and for a scientific theory it is remarkably immune to refutation. Second, there is now little doubt that the traits of personality are under heavy genetic influence (typically, heritability hovers somewhere between 40 and 60%). Third, even if the behaviorist account had merit, we would still have a legitimate right to want to know how observed effects are instantiated and processed by the brain. But these conclusions are not to discount the value of either a learning account or a reinforcement-based one. As shown below, both of these accounts have proved fruitful in the biological approach to personality.

Biosocial Perspective

If it is not possible to have a pure theory, what can be labeled 'biological' in personality psychology? For a start, such a theory would need to account for endocrine and physiological processes in explaining individual differences in response to the same environment. In this way, it lays emphasis upon internal agency, and not merely reactivity to external stimuli. We witness these features most clearly articulated in the first major biological approach to personality, namely H.J. Eysenck's arousal-activation (1967) theory.

The seeds of this major biological theory of personality were planted in Eysenck's 1944 seminal factor analysis of a medical checklist of 700 'war neurotics' invalidated out the British Army due to a failure of adaptation to the environment (in this case, military training during World War II). It will repay the student of personality psychology to consider the outlines of this theoretical approach as it reveals the assumptions of all biological theories of personality that took inspiration from it – and most did.

Eysenck's general approach was not so much 'biological' as 'biosocial.' It explicitly recognized that personality traits are the end product of the interaction of biological and social factors. In common with other biological theories of personality, Eysenck's theory points to the crucial role played by genetics and physiology, but he also pointed to the role of the *interplay* of genes/brain and the environment. Eysenck's starting point was to assume that human behavior and variations between people (i.e., 'personality') can be measured and classified in much the same manner as other biological phenomena – to him, there was nothing special about the 'mind,' no *élan vital*. His was a monist view of the mind/body (brain) problem.

A crucial assumption is that to the extent that environmental influences have lasting effects, they *must* go through the brain. By simple inference, individual differences in brain structure and functioning (heavily genetically influenced) affect the perception and analysis of the 'environment' and, thus, to a large extent, both define and determine its influence. For example, it is known that some people see events, as it were, through rose-tinted glasses, while for other people the hue of their glasses is blue. That is, given the same (objectively defined) event (the 'situation') there are different psychological consequences (e.g., emotional experience) depending on pre-existing dispositions (i.e., personality). At university, it is common for one student to perceive an examination as an opportunity to prove themselves, while for another student it is something to be dreaded – and these different psychological perspectives lead to different outcomes (emotional, cognitive, and behavioral, and in this example academic attainment). Contrary to purely social theories of personality, the environmental event (e.g., university examination) does not determine the psychological outcome; instead, biologically based individual differences in the construction and perception of the environment are the important ingredient. Today, this brain–environment interplay is a very fashionable topic of psychological research, seen in the guise of such effects as 'gene–environments interactions' (see below).

In Eysenck's personality theory, the conceptual bridge between the brain and the environment was conditioning (or more broadly speaking, learning). As there are significant individual differences in brain processes, so too there are differences between people in their rates of learning. This basic premise underlies many biological personality theories, which tend to focus on the role played by basic emotion and motivation systems, and how they lead to different forms of learning (i.e., modification of behavior by experience).

The biological approach also assumes that genetics provide a blueprint for the development of a specific phenotype (e.g., extraversion) but, critically, it is the interplay with environmental factors that determines what is observed – in much the same way that there must be a blueprint (or 'preparedness') for language acquisition but we all learn specific languages with local dialects.

Important questions are raised by this literature. How do biological processes affect perception and reactions to the environment? How do environmental factors affect biological processes? In other words, 'biological' and 'social' are bidirectional influences. Put another way, although nothing is more apparently 'biological' than DNA, this is merely a blueprint for potential development of the brain, which is proximally responsible for thoughts, feelings, and behavior. The brain is, indeed, a 'necessary' condition, but psychological phenotypes need 'sufficient' environmental conditions in order for them to develop and to be expressed.

A Functional Perspective

The search for the biological bases of personality traits must ask a number of questions, most important of which are What processes, and where to look for them? This problem is more real than apparent, and its resolution requires a conceptual

model of personality processes. The famous neuropsychologist Donald Hebb (1955) made the vital distinction between a 'conceptual nervous system' and the real 'central nervous system.' This distinction has proved important in suggesting how the scientific investigation of personality psychology might best proceed.

In order to understand why people react in different ways to the same stimulus or situation, we must first discover what drives people's actions and reactions. In the past, inferring motivation from observed behavior (and consistencies in behavior, 'personality') was something of a dark (and often murky) art. Psychoanalysis and a variety of 'projective' approaches may have enlivened psychology, but to many people they failed to throw proper scientific light on the true roots of motivation. Personality psychologists have looked elsewhere for inspiration.

One approach that has yielded theoretical fruit is based on the biology of motivational control systems. This approach operates on the premise that stable individual differences in behavior (personality traits) must be due to relatively stable individual differences in the operation of brain systems that produce (state) behavior from moment-to-moment. From this perspective, population-level traits reflect the operations of brain systems that have evolved to respond to different classes of functional requirements (Denissen and Penke, 2008). Accordingly, the search for biological underpinnings of personality should entail the search for answers to two questions: (1) What are the functions of specific reactions, and systems of reactions? and then (2) What is the neurophysiology of coordinated systems that mediate these reactions?

This functional approach has proved informative, and it has been augmented by two other approaches: The correlational approach (which biological processes are empirically associated with traits?); and the instantiation approach (what are the structures and workings of neurophysiological processes?). Most biological theories of personality combine different elements of these three approaches.

These approaches also help to differentiate the 'conceptual' (e.g., identifying the existence of causal systems by the construction of theories of behavior and learning) and 'real' (the 'wetware' of brain processes) nervous systems. In order to search for brain processes underlying the major systems of personality, it is necessary first to identify the existence of such systems by extracting separable factors of personality (traits) and building behavior-based accounts of such systems (e.g., classical and instrumental learning, and reward and punishment systems). One of the most comprehensive accounts of this whole literature is provided by Zuckerman (2005).

Functional accounts of personality have gained widespread popularity in recent years, and have afforded important insights in to human behavior. As discussed below, this approach provides a taxonomy of behaviors not in terms of the naming of traits and not even their specific behavioral outputs but, rather, in terms of the functions they serve. For example, different behavioral strategies (e.g., cooperation or coercion) may be identical in function (e.g., social influence) but their expression is influenced by context (e.g., power relationship). Contrariwise, the same behavior (e.g., cooperation) may serve different functions (e.g., altruism or submission), again depending on the context. Functions cannot simply be 'read-off' from behaviors; there is need for some form of conceptual nervous system to guide the search for the main systems of the real nervous system.

The functional perspective also throws light on the adaptive nature of, so-called, pathological behaviors and traits (e.g., anxiety and paranoia). The basic assumption is that personality traits – to the extent that they are systematic, genetically influenced, and pervade daily life – evolved by Darwinian natural selection, and thus have adaptive value – but this may not always be obvious. Adopting Darwin's hypothesis that psychological attributes are shaped by natural selection in much the same way as anatomical characteristics, modern personality theorists have come to favor accounts couched in terms of the functions of central states of emotion and motivation – an area of study suggested by Darwin himself in his work on the expressions of emotion in man and animals. These 'approach-avoidance theories' aim to describe the major systems that motivate behavior in reaction to classes of appetitive (rewarding) and aversive (punishing) stimuli, and to explain consistent patterns of individual differences in these behaviors. This literature is summarized by Corr (2013).

Approach-Avoidance Theories of Personality

Approach-avoidance theories of personality are based on the assumption that important classes of motivational stimuli can be grouped into 'rewards' and 'punishments.' Animals can be seen as cybernetic systems with attractors and repulsors (positive and negative goals) that have evolved to promote survival and reproduction. Without a tendency to approach beneficial stimuli (e.g., food, drink, and sexual mates) and to avoid aversive stimuli (e.g., predators and poisons) individuals and a whole species would simply not survive and pass on their DNA blueprint – the only thing that matters in biological inheritance.

Current approach-avoidance personality theories can trace their origins to early behavioral-learning researchers (e.g., Mowrer, 1960), who posited that two motivation/emotion processes underlie behavior: One related to reward (approach behavior and positive emotions), the other to punishment (avoidance behavior and negative emotions). This animal-based work migrated into personality psychology in the 1970s through the work of Jeffrey A. Gray (e.g., 1975), who argued that the major traits of personality reflect long-term stabilities in systems that mediate reactions to different classes of reinforcing stimuli, generating emotion and shaping ('motivating') approach and avoidance behavior. Neuroscience measures, including pharmacological manipulation, recording of neural activity, and neuroanatomical studies have been used to investigate the neuropsychological systems that underlie these reactions. A wealth of empirical research provides confirmation of the hypothesis that distinct and separable systems in the brain mediate reward and punishment-related emotion, motivation, and learning (Gray and McNaughton, 2000).

Personality Traits as Probabilistic Constants

To be of scientific value, a personality trait must be more than a score on a questionnaire: It must have predictive validity. In

biological theories, a personality trait is defined as a probabilistic constant in equations that predict the frequency and intensity with which individuals exhibit various motivational states, as well as the behavioral, emotional, and cognitive states that accompany these motivational states (Fleeson and Gallagher, 2009).

The biological approach aims to account for both the neuropsychological systems that are responsible for the states associated with any given trait and the parameters of those systems that cause them to differ across individuals. The systems themselves will be present in every intact human brain, but the values of their parameters will vary from person-to-person. Thus, for example, all people have brain systems that respond to punishments, but across individuals these systems respond differently to a given stimulus. It is the *typical* level of response of such a system in any given individual, averaged across different situations, that is associated with that individual's score on the personality trait in question. This is *not* to imply that an individual will respond the same way in all situations; rather, it implies that knowing the strength of the individual's trait predicts how he or she is likely to respond in a certain situation and, in particular, predicts variation in such responding across a set of individuals experiencing the same situation. This perspective means that the same person may respond quite differently in different situations (e.g., introverts under low and high level of arousal; Eysenck, 1967).

Many personality researchers have embraced this basic notion, and a number of personality models postulate traits reflecting sensitivity to reward and punishment (e.g., Elliot and Thrash, 2002). With the upsurge of neuroscience in psychology, there has been a marked increase of such theories, sometimes incorporated as part of larger theoretical schemes, associated with names such as Charles Carver, Robert Cloninger, Richard Davidson, and Jaak Panksepp. DeYoung and Gray (2009) summarize this large literature.

Reinforcement Sensitivity Theory of Personality

As Jeffrey Gray's early research was the principal impetus for reward/approach and punishment/avoidance concepts in mainstream personality psychology, and his work led to the formulation of the most elaborated biological theory of personality, it would be appropriate to use the current version of his theory, the reinforcement sensitivity theory (RST), to illustrate this broader scientific landscape.

Gray identified three primary systems that control reactions to punishment, reward, and conflict: The *fight-flight-freeze system* (FFFS), the *behavioral approach system* (BAS), and the *behavioral inhibition system* (BIS) (Gray, 1982; Gray and McNaughton, 2000; for summary, see McNaughton and Corr, 2008).

The one positive system, the BAS, is responsible for mediating reactions to all rewarding stimuli (which includes relief from nonpunishment) and it activates exploratory approach behavior. It is related to the emotion of hope and anticipatory pleasure and is measured by various personality scales, described below.

Turning to the defensive systems, the FFFS is responsible for mediating reactions to all punishing stimuli (which includes omission/termination of expected reward, and frustration), and is involved in active avoidance and escape behavior. It is related to the emotion of fear. In contrast, the BIS is activated by stimuli that indicate conflict between goals, especially between FFFS- and BAS-related ones. Upon activation, it inhibits the actions of the BAS and FFFS and generates cautious approach in potentially dangerous situations (i.e., passive avoidance). Also once activated, it generates risk assessment behavior, rumination, and increased arousal. Of interest, the BIS can be activated by the conflict of two opposing approach–approach goals, for example, receiving two equally appealing graduate school offers (the aversive component resides in the potential of making the wrong decision and incurring a relative loss). The BIS is related to the emotion of anxiety.

RST and Personality Traits

The most recent version of RST (Corr and McNaughton, 2008) proposes that the level of the trait Neuroticism reflects sensitivity to punishment and threat in general (both FFFS and BIS). However, within Neuroticism, there are two traits/emotions, each of which maps on to one of the two major systems for defensive behavior: *Fear* and *trait fearfulness* arise from the functioning of the FFFS; and *anxiety* and *anxiety-proneness* arises from variations in the sensitivity of the BIS.

Research evidence confirms that the personality traits associated with FFFS and BIS sensitivity are differentiable in measurement terms. Psychometric measures of fear and anxiety have been distinguished through confirmatory factor analysis (CFA), predictive validity studies, and associated facial expressions. Although Carver and White's (1994) widely used BIS scale was developed with only one avoidance system in mind, recent CFA studies show that this 'BIS' scale can be divided into separate FFFS (fear) and BIS (anxiety) components. There are now also studies using antianxiety and antipanic drugs to probe the FFFS and BIS, and these too support the separation of these systems. These studies are described by Corr et al. (2013)

Turning to BAS-related approach trait, Gray (1982) originally speculated that the trait associated with BAS sensitivity was 'impulsivity' largely because impulsive people are more likely to be sensitive to cues of the immediate possibility of reward. Although BAS sensitivity does play a role in impulsivity, researchers have since concluded that impulsivity is not its purest manifestation because it is determined not only by individual differences in the strength of impulses to pursue immediate reward but also by individual differences in the ability of top-down control systems to restrain and control those impulses (DeYoung, 2010). Indeed, Extraversion rather than impulsivity appears to represent the primary manifestation of BAS sensitivity in personality and various measures of reward sensitivity fall within the broad Extraversion factor (e.g., Gable et al., 2003).

Breaking down reward sensitivity into subfactors has not been as systematic as the approach to identifying traits associated with BIS and FFFS, largely because Gray elaborated only a single reward system. However, the most commonly used measure of BAS sensitivity has three subscales: Drive, Reward Responsivity, and Fun Seeking (Carver and White, 1994). Whereas Drive and Reward Responsivity both appear to characterize sensitivity to reward primarily, Fun Seeking appears to be equally related to impulsivity, and thus may not be as pure

an indicator of BAS sensitivity. How this biological model of personality is related to the population-level factors identified by the Big Five research tradition is summarized by Corr et al. (2013).

Genetics of Personality

One of the major correlational approaches to understanding the biology of personality factors and their underlying processes is genetics, which is seen in two forms: (1) Statistical/behavioral, and (2) molecular. This literature is reviewed by Munafo (2009).

Statistical/Behavioral Genetics

Using twin and adoption designs, this approach attempts to decompose the variance in some phenotype (e.g., Neuroticism) into genetic and nongenetic (i.e., 'environmental') components. By this means, heritability estimates are calculated. The literature shows that for almost all personality factors there is a substantial heritability (40–60%). Increasingly elaborate designs are being used to tease part genetic and environmental influences (e.g., new families after divorce which often have children with different biological fathers).

Molecular Genetics

In the case of molecular genetics, the approach is to find statistically significant associations between the frequencies of specific genetic variants (i.e., alleles) and scores on personality questionnaires. There are two main techniques used. The first is 'candidate gene' association technique, which first identifies specific genes thought to be important in the causal processes.

Candidate gene studies take as their starting point what is already known about the neurobiology of the trait of interest. This is used to identify genetic 'candidates,' in other words, genes that encode products involved in relevant neurotransmitter pathways. For example, when studying anxiety-related traits, such as neuroticism, genes involved in the serotonin pathway are the likely candidate, while for approach-related traits, such as extraversion or novelty seeking, genes involved in the dopamine pathway are the focus. As well as identifying a candidate gene in this way, it is necessary to identify a polymorphism within this gene (i.e., a region that can exist in multiple forms, 'alleles'). Genetic variation at this locus should, therefore, confer biological individual differences, which in turn should result in behavioral (phenotype) differences between people (e.g., anxiety).

The second approach is 'genome-wide association studies,' which takes a blind atheoretical approach and scans the entire genome for 'hot spots' of association – often revealed by Manhattan plots which highlight 'tall' associations. A very large number (500 000+) of genetic markers are examined to determine if any are related to the phenotype of interest and, if so, to what extent. Then, once the associated genetic markers are reliably identified, the process of exploration of the function of the related genes can start in earnest. Once again, the aim is to look for a significant correlation between genetic variation and phenotypic variation. To achieve reliable results, very large sample sizes are needed as the genetic associations are typically very small (usually less than 1% of phenotypic variance).

Although it is well-established that heritability for personality traits is substantial, the search for specific genes has not yet proved successful. This result may be due to several factors: The very small effect sizes of individual genes; the interaction of genes and the environment; and a basic lack of knowledge concerning how genes confer their effects on brain development and the expression of phenotypes. Certainly, the candidate gene literature is characterized by a pattern of early excitement followed by disappointment (Ebstein, 2006) as results have failed to replicate on independent samples.

Another reason for this lack of success may be the possibility of interactions between genes. This possibility is suggested by the work of Reuter et al. (2006) who found a significant DRD2 by COMT interactions (i.e., epistasis) for the Carver and White (1994) total BAS scale as well as for the subscales Drive (D) and Fun Seeking (FS). The details of this interaction are much less interesting than its existence: Genes may work together in influencing specific phenotypes.

Gene-by-Environment Interactions

There are now new approaches to exploring just how genes and the environment work together. This work throws new light on the role played by genes, but also what is meant by 'the environment.' To illustrate this approach, Poulin et al. (2012) found that genes act in tandem with a person's perceptions of the world (e.g., whether it is perceived to be threatening or not) to predict their level of generosity. Individuals who believe their surroundings are threatening are less likely to help others. However, this was found only in those individuals who lacked the gene variant that enable them to overcome their negative feelings. Specifically, genes related to oxytocin and vasopressin (hormones known to be related to maternal and prosocial behaviors) modify the effects of perceived threat (a measure of the environment) to predict engagement in volunteer work, charitable activities, and commitment to civic duty.

Neuroimaging and Personality

The biological approach to personality was given great momentum by the availability of functional neuroimaging (principally, magnetic resonance imaging, MRI), which permits direct investigation of the brain processes associated with an experimentally controlled performance task – this functional MRI is distinct from structural MRI, which is valuable in its own right (and comes as a 'freebie' with fMRI). It is now possible to relate personality traits to these brain processes. Although this literature is still in its infancy, it is already making progress in showing the brain instantiation of personality processes. This literature is summarized by Canli (2009).

Recent fMRI studies have demonstrated remarkably powerful and expected associations between personality traits, measured by a simple questionnaire, and brain activity during a number of cognitive and affective tasks (e.g., Mobbs et al., 2005).

Before the availability of functional brain imaging the only way to measure brain activity was with the use of electroencephalograms and event-related potentials – these remain valuable methods and are still used, especially because of their high temporal resolution (in milliseconds). The other main technique used by early researchers of personality and brain

function was lesions sustained through accidents or disease (or experimentally induced in laboratory animals, typically rats). These more traditional techniques still play a role, albeit a relatively declining one, in biological personality psychology.

As a specific example of utility of fMRI in relation to RST, Cunningham et al. (2010) provide evidence for different associations between FFFS- and BIS-related traits on amygdala activity (which is a brain region crucially involved in the detection of motivational salience). Their pattern of findings is consistent with the idea that the FFFS responds to all punishing stimuli, whereas the BIS responds to conflict associated with concurrent approach tendencies.

Conclusion

Biological theories of personality have made significant progress, in both theoretical elaboration of conceptual systems as well as uncovering the genetic and neurophysiological bases of systematic individual differences in thinking, feeling, and behaving. This research is embedded in a much broader conceptual framework of personality description and social-environmental influences. Gene-by-environment interaction studies are proving especially insightful, including showing how 'the environment' is, in many respects, a psychological construction of the brain and, itself, influenced by genetic factors.

See also: Agreeableness; Behavioral Inhibition and Social Withdrawal across Cultures; Conscientiousness; Emotions, Psychological Structure of; Extraversion; Facial Emotion Expression, Individual Differences in; Five Factor Model of Personality, Assessment of; Imaging Methods in Clinical Psychology; Motivation in Clinical Interventions; Neuroticism; Openness to Experience; Panic Disorder and Agoraphobia Across the Lifespan; Pathological Gambling and Gambling Disorder; Personality Assessment; Personality Changes During Adolescence Across Cultures; Personality Differences and Development: Genetic and Environmental Contributions; Personality Theory and Psychopathology; Personality, Evolutionary Models of; Personality, Trait Models of; Phobias Across the Lifespan; Projective Methods in Psychology; Reinforcement, Principle of; Social Phobia across the Lifespan; Temperament Development, Theories of; Temperament and Human Development; Temperament.

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http://www.philipcorr.net – Professor Philip Corr Psychological Research.
http://www.psychol.cam.ac.uk/personalityproject – University of Cambridge Department of Psychology.
http://www.psychometriclab.com – London Psychometric Laboratory at UCL.