Personality, Individual Differences and Intelligence

Fifth Edition

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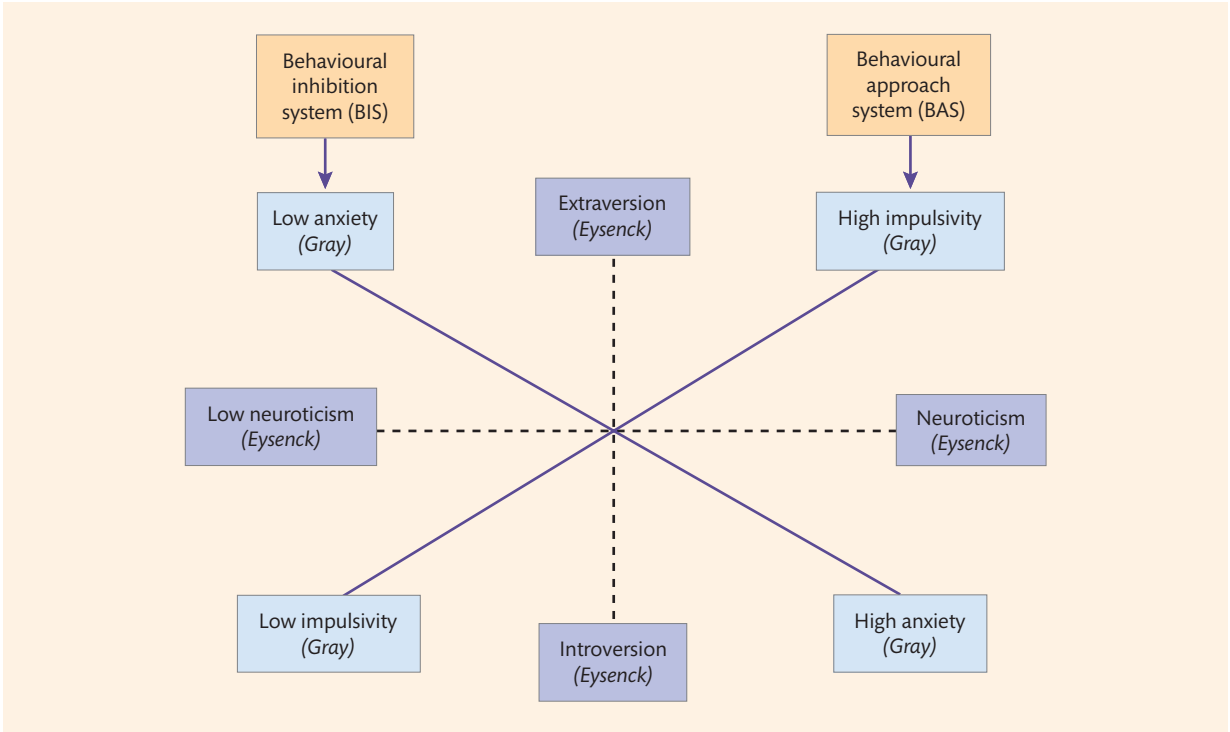

Figure 8.6 The relationship between Gray's model and Eysenck's model of personality and arousal.

and wage raises rather than suggest possible punishments, such as redundancies. Conversely, if you want to motivate anxious people, you would do better to indicate the possibilities of punishment rather than offer promotions and wage rises. For example, we can imagine how an impulsive person would spend their work days doing things looking for promotion, never concerning themselves with the possibility of losing their job. We can also imagine how an anxious person in work worries about the possibility of the sack, rather than potential promotion, thinking they would never be able to reach such heights.

A research example of how the BAS and the BIS work was carried out by Finnish psychologists Tarja Heponiemi, Liisa Keltikangas-Järvinen, Sampsa Puttonen and Niklas Ravaja (2003). This research concentrates on looking at the effects of reward and punishment on positive and negative feelings alongside measures of the BAS and the BIS. In this experiment, the researchers measured the BAS and the BIS using the original version of Carver and White's BIS/BAS scales that measured only the BAS and the BIS systems. The researchers also asked participants in the experiment to complete a number of tasks, during which they were asked to indicate each time their own levels of positive and negative emotion. The tasks that participants were asked to complete included tasks designed to induce a negative experience (punishment tasks, such as being startled by a loud noise, and a reaction-time task where completion is done within a set time while loud noises are being played) and a task designed to induce a positive experience (reward) – a mental arithmetic task with a monetary prize ($40) for the best performance. Heponiemi and colleagues found that a greater degree of behavioural approach was related to more positive feelings during the appetitive math task. Additionally, they found that a greater degree of behaviour inhibition was related to more negative feelings during aversive tasks and especially during the startle task (Figure 8.6).

Cloninger's biological model of personality

C. Robert Cloninger, a US biological psychiatrist, proposed a psychobiological personality theory, including seven personality dimensions (Cloninger, 1987). His theory of personality is based on combining findings from a series of family, psychometric, neuropharmacologic (a branch of medical science dealing with the action of drugs on and in the nervous system) and neuroanatomical (a branch of anatomy that deals with the nervous system) studies of behavioural conditioning and learning in man (Cloninger et al., 1993).

To begin with, Cloninger's model included only three dimensions, but it has since been expanded to include seven domains of personality. The theory of personality is broken down into four *temperament* domains:

- Novelty-seeking
- Harm avoidance
- Reward dependence
- Persistence.

and three *character* domains:

- Self-directedness
- Cooperativeness
- Self-transcendence.

The temperament domains are the areas we are most interested in from a personality perspective. Like the theories of Eysenck and Gray, they are linked to biological systems and are thought to be inherited. The four temperaments are thought to be organised as independent brain systems aligned to specific nerve cells or fibres that transmit nerve impulses by neurotransmitters. Neurotransmitters are chemicals that are used to relay, amplify and modulate electrical signals in the brain. Cloninger links our personality to those neurotransmitters that are responsible for the activation and inhibition of our behaviour and the learning and responses to both real and perceived rewards and punishments. Cloninger's four temperament dimensions are:

- **Novelty-seeking** – This dimension reflects impulsive behaviour and activation of behaviour. The key term to describe novelty-seeking is 'behaviour activation'. Novelty-seeking is a tendency to like excitement, responding to novel stimuli. A person who scores high on novelty-seeking likes to explore, meet new people and find out about new things. Novelty-seeking is thought to be connected to the dopamine neurotransmitter. Dopamine is crucial to the parts of the brain that control our movements and is commonly associated with the pleasure aspects of the brain, providing feelings of enjoyment and motivation to do things. In the frontal lobes of the brain, the part of the brain involved with planning, coordinating, controlling and executing behaviour, dopamine controls the flow of information from other areas of the brain. You can clearly see that Cloninger is using the brain's operations regarding motivation, enjoyment and planning to do things to define the temperament of novelty-seeking.
- **Harm avoidance** – This dimension reflects cautious and low-risk-taking behavioural traits. The key term to describe harm avoidance is 'behaviour inhibition'. Harm avoidance includes a tendency to respond intensely to aversive stimuli or to inhibit behaviour in order to avoid punishment or novelty. People who display harm avoidance traits are afraid to try out new things or are shy with people. Harm avoidance is thought to be connected to the serotonin (or 5-hydroxytryptamine, 5-HT) neurotransmitter that is known to modulate mood, emotion and sleep, and it is involved in the control of numerous behavioural and physiological functions.
- **Reward dependence** – This dimension reflects friendliness and a tendency for seeking rewards. People who are high on reward dependence respond well to reward, such as verbal signals of social approval or positive responses from other people. The key term to describe reward dependence is 'behaviour maintenance'. Reward dependence is thought to be connected to norepinephrine (also called noradrenaline). Norepinephrine is a stress hormone that affects parts of the human brain where attention and impulsivity are controlled. It is related to activation of the sympathetic nervous system, which regulates our responses to stress.
- **Persistence** – This dimension reflects a tendency to persevere in behaviour despite frustration and tiredness. Someone high in persistence would have the ability to stay with a task and not give up easily. Persistence wasn't in Cloninger's model originally but emerged from the reward dependence dimension. Cloninger had found, when trying to measure reward dependence, that certain items relating to persistence weren't associated with reward dependence. Persistence also represents behaviour maintenance. Similarly to reward dependence, this dimension is thought to be connected to norepinephrine.

The character traits in Cloninger's theory contrast to temperaments because they are not biological in origin, but rather refer to how individuals understand themselves in their social world. Character traits represent our emotions, habits, goals and intellectual abilities that we have formed in response to the outside world. Cloninger's three character traits are:

- **Self-directedness** – This trait reflects the individual's own concept of how autonomous a person is; for example, the extent to which they are independent in mind or judgement. In this dimension people show feelings such as self-esteem, personal integrity and leadership.
- **Cooperativeness** – This trait is based on the person's self-concept of how they fit into humanity or society. Feelings of morality, ethics, community and compassion are included in this dimension.
- **Self-transcendence** – This trait reflects individuals' self-concept in terms of their common beliefs about mystical experiences. Concepts such as religious faith and spirituality are formed within this dimension.

Although Cloninger separated out temperament and character traits, he did propose that the two interact. For example, individuals with the same temperament may behave differently as a result of character development. For example, one person might be high in novelty-seeking and also high in cooperativeness, and consequently, they might spend a lot of their time going out and seeking to raise money by doing a lot of charity work. Another person might be high in novelty-seeking and also high in self-transcendence, and therefore, they might travel the world exploring their spirituality by visiting a number of countries with different religious and spiritual backgrounds.

Cloninger's model of personality is measured by the Temperament and Character Inventory-Revised (TCI-R), which contains 240 items. Responses are scored on a five-point scale (1, definitively false; 2, mostly or probably false; 3, neither true nor false, or about equally true or false; 4, mostly or probably true; 5, definitively true). These items reflect each of the temperament and character dimensions, for example:

- **Novelty-seeking** – These items ask the individual about how excitable, exploratory, impulsive and extravagant (high novelty-seeking) they are, as opposed to how reserved and reflective they are (low novelty-seeking).
- **Harm avoidance** – These items ask the individual about how much they worry and are pessimistic, fearful of uncertainty and shy (high harm avoidance) versus how optimistic they are (low harm avoidance).
- **Reward dependence** – These items ask the individual about how attached and dependent they are (high reward dependence) versus how detached and independent they are (low reward dependence).
- **Persistence** – These items ask the individual about their responses to potential rewards, their ambitiousness, their perfectionism (high persistence) versus their laziness, frustration when not achieving and their tendency to quit when faced with obstacles (low persistence).
- **Self-directedness** – These items ask the individual about their tendency to act and take responsibility, their purposefulness and resourcefulness (high self-direction) versus their tendency to blame people and have a lack of self-direction (low self-direction).
- **Cooperativeness** – These items ask the individual about their feeling of social acceptance, empathy and helpfulness (high cooperativeness) versus their social intolerance, social disinterestedness and tendency to want to take revenge (low cooperativeness).
- **Self-transcendence** – These items ask the individual about their tendencies to identify with transpersonal ideas and spiritual acceptance (high self-transcendence) versus a tendency to emphasise materialism (low self-transcendence).

Clearly there are links between Cloninger's model of personality and Eysenck's and Gray's models of personality. Novelty-seeking is thought to mirror Eysenck's extraversion, and harm avoidance is thought to mirror Gray's behavioural inhibition and Eysenck's neuroticism. Also, Cloninger's reward dependence seems to be equivalent to Gray's behavioural approach system.

Empirical evidence for biological theories of personality

In the last section, we introduced three theories that have linked personality variables to psychophysiological and neuropsychological processes. But how do researchers set about establishing such links? In this section we are going to give you a brief introduction to the types of physiological measures and studies that are used to examine whether these biological personality dimensions are related to psychophysiological and neuropsychological processes. What we are interested in most, here, is direct evidence that links physiological factors to personality dimensions, because then we would be able to show that there is a biological basis to the theories of Eysenck, Gray and Cloninger. There is a lot of research that looks at this area, so, to give you the best idea of the sort of physiological measures and physiological evidence for biological theories, we are going to use the 1999 summary of psychologists Matthews and Gilliland (1999), who looked at the biological personality theories of Eysenck and Gray.

Now, it is crucial to remember what we are looking for. With Eysenck's theory we are looking for extraversion being related to physiological measures of stimulation, and neuroticism being related to physiological measures of emotion. With Gray, we would expect to find that anxiety is associated with high sensitivity to signals of punishment and impulsivity, with high sensitivity to signals of reward.

UK psychologists Matthews and Gilliland (1999) suggest that two sets of measures have been used to examine these aspects of Eysenck's and Gray's theories: (1) measures of the central nervous system; and (2) measures of the autonomic nervous system.

The central nervous system and biological personality dimensions

The central nervous system comprises the brain and spinal cord; this system supervises and coordinates the activity of the entire nervous system and is the part of the body that transmits information to, and from, our senses or sensations. Measures of the central nervous system involve measuring brain activity.

A first measure of central nervous system activity is the **electroencephalogram (EEG)**. The EEG, a measure of the electrical activity produced by the brain, is obtained by placing electrodes on the scalp and is presented in waveform. The waveform can then be analysed and is broken down into four ranges: delta, theta, alpha and beta. Electrical activity that falls within the **beta range** is considered to reflect activity, while electrical activity that falls within the **alpha range** is considered to reflect low states of arousal.

Remember that, in Eysenck's theory, we are looking for extraversion being related to physiological measures of stimulation, and neuroticism being related to physiological measures of emotion. Gale (1973; 1983) reviewed a number of studies suggesting support for Eysenck's theory. In reviewing these studies, Gale shows that, when placed in aroused situations, introverts tend to show significantly higher levels of alpha activity (low arousal) than extraverts do. However, Swedish psychologist George Stenberg

(1992) found no significant relationship between a number of EEG measures and either extraversion or neuroticism.

A second measure of central nervous system activity suggested is the **event-related potential (ERP)**. The ERP, like the EEG, measures electrical activity in the brain, but does so in response to stimuli in the environment. ERP is measured by responses within the first 100–500 milliseconds following stimuli, and Eysenck (1994) explains that waveforms of 300 milliseconds, something called P300, indicates when the cortical systems are showing arousal. Stelmack and Houlihan (1995) found higher levels of P300 amplitudes (arousal) in introverts and neurotics in response to stimuli, which suggests higher arousal and supports Eysenck's model. However, Matthews and Gilliland note that there are very few replications of this finding. In terms of extraversion and ERP, Fishman et al. (2011) found that higher scores on extraversion were found to be associated with higher amplitudes of the P300 component of the ERPs in response to human faces (i.e. a social based stimuli).

There is evidence to support Gray's theory of personality. With Gray we would expect to find that anxiety is associated with high sensitivity to signals of punishment and impulsivity with high sensitivity to signals of reward. Again, research has concentrated on similar measures of the central nervous system (i.e. EEG and ERP measures). For example, Stenberg (1992) found that impulsive participants showed signs of lower arousal, and more anxious participants showed higher levels of the beta waveform (remember that the beta range is considered to reflect activity) in response to negative emotional stimuli.

However, Matthews and Amelang (1993) and Matthews and Gilliland (1999) have suggested that the significant relationships between personality traits of both Eysenck and Gray and EEG and ERP measures are often very small, suggesting that the evidence supporting the predicted relationship between personality and brain activity is weak.

The autonomic nervous system and biological personality dimensions

The autonomic nervous system is the part of the brain that regulates unconscious or involuntary actions of the body, such as muscles, heart rate and glands (that produce secretions from the body, such as sweating). Measures of the autonomic nervous system measure those systems that are associated with regulating arousal (for example, the heart). Two further sets of measures tend to be used: cardiovascular and electromodal. Cardiovascular measures involve measuring the heart and the blood vessels. **Electromodal measures (EDA)** ascertain the electrical activity of the skin. There are two main ways of classifying EDA measures:

- **Baseline EDA measures** – are often obtained through a small electric current to the skin via an electrode leading to the measure of skin resistance or skin conductance.
- **Phasic EDA measures** – are skin responses to known stimuli, such as caffeine, noise or visual stimuli.

In applying Eysenck's theory, cardiovascular activity (e.g. heart rate) should be higher in neurotics and introverts as they both get upset by arousal and over-arousal, and EDA measures should be able to discriminate between introverts and extraverts. Some studies have explored the relationship between arousal and personality using cardiovascular activity. Richards and Eves (1991) found increased heart rate to arousal stimuli among introverts, though Naveteur and Roy (1990) did not. In terms of EDA measures, Matthews and Gilliland suggest that overall studies using baseline EDA measures have provided little information that supports Eysenck's theory, but studies using phasic EDA measures found general support for Eysenck's model. For example, Smith (1983) and Fowles et al. (1977) found evidence that introverts have higher levels of EDA than extraverts do where respondents are presented with arousal stimuli such as caffeine or stress. However, neuroticism is not generally found to be related to EDA measures (Matthews and Gilliland, 1999).

Biological personality dimensions and other biological and physiological systems

There are other studies that link biological personality dimensions to other biological and physiological systems. Dopamine is a neurotransmitter (it transmits signals from a neuron to cells) that regulates emotional responses and activity. Dopamine not only allows us to recognise rewards but also engage in behaviour that seeks out those rewards. Depue and Collins (1999) found that extraversion was related to higher sensitivity of the mesolimbic dopamine system (a pathway within the brain that carries dopamine from one part of the brain to another). Cohen et al. (2005) also found extraversion to be related to dopamine activation during a gambling task. This finding suggests that extraversion is associated with a physiological system that recognises and seeks out rewards.

Johnson et al. (1999) have found extraversion to be related to blood flow activity in the anterior cingulate cortex (thought to be related to reward anticipation, as well as regulating blood pressure and heart rate), **temporal lobe** (contains the hippocampus and is important in the formation of long-term memories) and the posterior thalamus (relays sensory and motor signals to the cerebral cortex). Again, this finding suggests that extraversion is related to reward-sensitive regions of the brain.

A lot of research has concentrated on the effects of reward and punishment on physiological measures among impulsive and anxious people, as according to Gray's theory. Gray's theory asserts that anxiety is associated with high sensitivity to signals of punishment and

impulsivity (best described as the behavioural approach system within his theory), with high sensitivity to signals of reward. One example is the study carried out by US psychologists Peter Arnett and Joseph Newman (2000). Arnett and Newman studied prison inmates at a minimum security prison in southern Wisconsin. These researchers measured a number of physiological responses while the prisoners took part in an experiment that involved positive and negative stimuli that were linked to gaining money or losing small amounts of money. Among this sample, there were increases in heart rate when participants were given a reward. This finding is consistent with predictions around the behavioural approach system and the theory that rewards are related to physiological responses. Arnett and Newman also found that participants showed significant increases in the electrical activity of the skin in response to punishment. This finding is consistent with predictions around the behavioural inhibition system regarding punishment and its relationship to physiological responses.

Consideration of biological theories of personality

The strength of biological theories of personality (Eysenck, Gray and Cloninger) is that they use important psychological mechanisms to explain the different dimensions of personality. Within these theories the concepts of arousal, activation and inhibition are important variables that allow personality to be linked to many different types of behaviours and responses to stimuli. Of particular note is Eysenck's theory of arousal and personality as this was the first modern attempt to examine personality within biological factors. The fact that it was developed before many modern physiological measures were developed certainly was an admirable attempt to try to understand human behaviour in relation to brain and body functioning. We can also see from some of the evidence that is outlined that personality dimensions are linked to physiological activity such as brain activity (EEG and ERP) and EDA measures (skin conductance or heart rate).

However, the main problem with biological theories of personality is the lack of consistent evidence supporting these theories. For example, Matthews and Gilliland (1999) suggest that, when you consider the EEG studies looking at Eysenck's personality dimensions, the relationships that are found to be consistent with Eysenck's theory tend to be weak. There is very little evidence to suggest that neuroticism is related to arousal. If Eysenck's theory should be deemed adequate, given that we are dealing with biological factors, the research evidence should perhaps be much stronger and much more consistent. Such a problem is found with research evidence across Eysenck's, Gray's and Cloninger's theories; although sometimes evidence is found to support the theory, sometimes it is not, and usually the results are not strong enough. Matthews and Gilliland (1999) suggest the reason for this might be that Eysenck's, Gray's and Cloninger's theories may have oversimplified a number of biological processes in their theory. For example, Zuckerman (1991) illustrates that the ascending reticular activating system (ARAS), thought to be a major system in Eysenck's theory, may not be as important to arousal as Eysenck thought. Arousal has been found to affect other aspects of the brain, and Eysenck's view that the ARAS regulates arousal by switching it on and off may represent an oversimplification of the brain. Furthermore, although Gray's and Cloninger's theories are more recent developments, they may also represent an oversimplification of complicated biological processes. As we noted before, there are links between Cloninger's model of personality and Eysenck's and Gray's models. Novelty-seeking is thought to mirror extraversion, and harm avoidance is thought to mirror Gray's behavioural inhibition and Eysenck's neuroticism. Also, Cloninger's reward dependence seems to be equivalent to Gray's behavioural approach system. However, there are differences between the personality theories in terms of which parts of the brain the theory emphasises. While Eysenck emphasises the ARAS and arousal, Gray emphasises two separate systems, the behavioural approach system (BAS) and the behavioural inhibition system (BIS), and Cloninger links the personality to dopamine, serotonin and norepinephrine. As evidence is found for each of the theories, it is probably likely that, on their own, each theory represents an oversimplification of the brain processes, and a combination of the different brain systems and activities identified by these theorists may best explain a biological basis to personality.

Together then, there does seem to be some biological evidence to support biological theories of personality. Reviews of the area, such as Matthews and Gilliland's (1999), suggest that further work needs to be done to explore such theories of personality fully. None the less, Eysenck's, Gray's and Cloninger's theories clearly link a number of personality and individual difference variables to neural processes, although their theories have had varying degrees of success in demonstrating this link empirically. Even so, these theories may produce important and dynamic foundations to expand our understanding of personality.

Final comments

The aim of this discussion was to introduce you to theories that explore biological bases of personality, behavioural genetics, neuropsychology and psychophysiology. We have shown you how psychologists have applied the ideas that surround behavioural genetics and heritability estimates to understand influences on personality. We have presented theoretical and

research evidence surrounding genetic and environmental influence on personality that can be used to assess the value of heritability estimates. We have shown you how Eysenck, Gray and Cloninger have used neuropsychology and psychophysiology concepts to develop biological models of personality. We have also given you some evidence and general comments to assess the strengths and weaknesses of biological models of personality.

Stop and think

Personality and arousal, reward and punishment

1 Consider whether you are more an impulsive person or an anxious person. Do you generally respond well to reward or punishment?
2 Consider whether you are more an impulsive person or an anxious person in two situations: (1) when you are working or in university; or (2) when you are with your friends. Try to examine whether you respond well to reward or punishment in these situations.
3 Imagine you are a teacher trying to teach a class a new skill. Within this class some of the students are extraverted, some are impulsive, some are neurotic and some are anxious. Discuss how the issues of arousal, reward and punishment are going to influence how you teach the class this new skill.

Summary

- Two terms that are important to know in this area of study in behavioural genetics are genotype and phenotype.
- Three types of studies that you will regularly see in this research area are family studies, twin studies and adoption studies.
- These types of studies have been used to develop genetic heritability estimates of personality.
- A number of American, Australian and European samples consistently suggest that there is moderate heritability of personality from genetic factors accounting for from 20 to 50 per cent of phenotypic variance across a number of samples and cultures.
- Where previously researchers used the *additive assumption* to compare genetic versus environmental effects on personality, behaviour geneticists consider a number of genetic and environmental influences on personality.
- There are six general issues surrounding genetic heritability estimates of personality. These centre on conceptions of heritability and the environment, different types of genetic variance, shared versus non-shared environmental influences, the representativeness of twin and adoption studies, assortative mating and the changing world of genetics.
- Reiss outlines three models of genetic transmission in which inherited genes form phenotypes based on the family environment: the passive model, the child-effects model and the parent-effects model.
- Harris presents the group socialisation theory to explain the importance of non-shared environmental factors in personality. Harris lists five aspects that are important to consider: context-specific socialisation, outside the home socialisation, transmission of culture via group processes, group processes that widen differences between social groups and group processes that widen differences among individuals within the group.
- Eysenck proposes that extraversion–introversion personality traits are related to the arousal of the reticulocortical circuit, and that, for extraverts and introverts, the ascending reticular activating system (ARAS) operates in different ways, particularly in terms of arousal.
- Gray's reinforcement sensitivity theory proposes that personality is based on the interaction between two basic systems in the brain: the behavioural approach system (BAS) and the behavioural inhibition system (BIS). Gray linked this theory to two personality variables: impulsivity and anxiety.
- Cloninger identified four temperaments (novelty-seeking, harm avoidance, reward dependence and persistence) and three characters (self-directedness, cooperativeness and self-transcendence). Cloninger links the personality dimensions to dopamine, serotonin and norepinephrine.
- Physiological evidence for biological theories of personality is weak and inconsistent, but there is some evidence for these theories that may provide important and dynamic foundations to understanding personality.