Modern Biosocial Perspectives of Criminal Behavior

This section will discuss the more modern biological studies of the 20th century. We will begin with studies from the early 1900s, particularly those that sought to emphasize the influence of biological factors on criminality. Virtually all of these studies have shown a significant biological effect in the development of criminal propensities. Then we will examine the influence of a variety of physiological factors, including chromosomal mutations, hormones, neurotransmitters, brain trauma, and other dispositional aspects of individuals' nervous systems. A special emphasis will be placed on showing the consistent evidence that has been found for the interaction between physiological and environmental factors (i.e., biosocial factors).

This section will examine a variety of perspectives that deal with interactions between physiological and environmental factors, which is currently the dominant model explaining criminal behavior. First, we will discuss the early studies that attempted to emphasize the biological aspects of offending: familial, twin, and adoption studies. All of these studies show that biological influences are more important than social and environmental factors, and most also conclude that when both negative biological and disadvantaged environmental variables are combined, these individuals are by far the most likely to offend in the future, which fully supports the interaction between nature and nurture factors.

Later in this section, we will examine other physiological factors, such as hormones and neurotransmitters. We will see that chronic, violent offenders tend to have significantly different levels of hormones and other chemicals in their bodies than do other individuals. Furthermore, we will examine brain trauma and activity among violent offenders, and we will see that habitual violent criminals tend to have slower brain wave patterns and lower anxiety levels than other persons. Ultimately, we will see that numerous physiological distinctions can be made between chronic violent offenders and others but that these differences are most evident when physical factors are combined with being raised in poor, disadvantaged environments.
Nature versus Nurture: Studies Examining the Influence of Genetics and Environment

At the same time that Freud was developing his perspective of psychological deviance, other researchers were busy predicting criminality. This type of testing produced four waves of research: family studies, twin studies, adoption studies of identical twins separated at birth. Each of these waves of research contributed to our understanding of how much criminality is inherited from our parents (or other ancestors) versus how much is due to cultural norms, such as family or community. Ultimately, all of the studies have shown that the interaction between these two aspects—genetics and environment—is what causes crime among individuals and groups in society.

Family Studies

The most notable family studies were done in the early 1900s by Dugdale, in his study of the Jukes family, and the previously discussed researcher Goddard, who studied the Kallikak family. These studies were supposed to test the proposition that criminality is more likely to be found in certain families, which would indicate that crime is inherited. Due to the similarity of the results, we will focus here on Goddard’s work on the Kallikak family.

Goddard thought that many of the individuals (often children) from the Kallikak family actually looked this family to back up these claims. However, follow-up investigations of Goddard’s research have shown that many of these photographs were actually altered to make the subjects appear more sinister or evil (fitting Lombroso’s stigmata by altering their facial features, most notably their eyes).

Despite the descriptive methodology problems with Goddard’s data and subsequent findings, two important conclusions can be made from the family studies that were done in the early 1900s. The first is that criminality is shown to be a product of heredity or genetics. After all, individuals from the same family are also products of a regarding the relative influence of nature versus nurture in terms of predicting criminality.

The second conclusion of family studies was more insightful and interesting. Specifically, they showed that children then did not the father’s criminality. This is likely due to two factors. The first is that the father is often absent to transgress social norms and become a convicted offender, which indicates that the mother is highly antisocial; second, it should be apparent from the weaknesses in the methodology of family studies that this finding did not job of measuring the influence of genetics versus environment, which was twin studies.

Twin Studies

After family studies, the next wave of tests done to determine the relative influence on criminality between nature and nurture involved twin studies, the examination of identical twin pairs versus fraternal twin pairs. Identical twins are also known as monozygotic twins because they come from a single (hence mono) egg (zygote), they are typically referred to in scientific literature as MZ (monozygotic) twins. Such twins share 100% of their genotype, meaning they are identical in terms of genetic makeup. Keep in mind that everyone shares approximately 99% of the human genetic makeup, leaving about 1% that can vary over the entire species. On the other hand, fraternal twins are typically referred to as dizygotic twins because they come from two (hence all) separate eggs; they are known in the scientific literature as DZ (dizygotic) twins. Such DZ twins share 50% of genes that can vary, which is the same amount that any siblings from the same two parents share. DZ twins can be of different genders and may look and behave quite differently, as many readers have probably observed.

The goal of the twin studies was to examine the concordance rates between MZ twin pairs and DZ twin pairs regarding delinquency. Concordance is a count based on whether two people (or a twin pair) share a certain trait (or lack of the trait); for our purposes, the trait is criminal offending. Regarding a count of concordance, if one twin is an offender, then we look to see if the other is also an offender. If that person is, then we say there is concordance between the two offenders. If, however, the other twin is not an offender, then this would be discordant, in the sense that one has a trait that the other does not.

Thus, the twin studies focused on comparing the concordance rates of MZ twin pairs versus those of DZ twin pairs, with the assumption that any significant difference in concordance could be attributed to the similarity of the genetic makeup of the MZ twins (which is 100%) versus the DZ twins (which is significantly less, that is, 50%). If genes play a major role in determining the criminality of individuals, then it would be expected that MZ twins would have a significantly higher concordance rate for being criminal offenders than would DZ twins. In these studies, it was assumed that each twin in each MZ or DZ twin pair had been raised in more or less the same environment as the other twin, since each pair had been brought up in the same family at the same time.

A number of studies were performed in the early and mid-1900s that examined the concordance rates between MZ and DZ twin pairs. These studies clearly showed that identical twins had much higher concordance rates than did fraternal twins, with most studies showing twice as much concordance or more for MZ twins, even for serious criminality.

However, the studies regarding the comparisons between the twins were strongly criticized for reasons that many readers today see. Specifically, identical twins, who look almost exactly alike, are typically dressed the same by their parents and treated the same by the public. In addition, they are generally expected to behave the same way. However, this is not true for fraternal twins, who often look very different and quite often are of different genders.
Adoption Studies

Due to the valid criticisms leveled at twin studies in determining the relative influence of nature (biological) or nurture (environmental), researchers in this area moved on to adoption studies, which examined the predictive hold. It is important to realize that, in such studies, the adoptees were typically given up for adoption prior to six months of age, meaning that the biological parents had relatively no interaction with their natural children; rather, they were almost completely raised from infancy by the adoptive parents.

Perhaps the most notable of the adoption studies was done by Sarnoff Mednick and his colleagues, in which they examined male children born in Copenhagen between 1927 and 1941 who had been adopted early in life. In future criminality was found for adopted youths who had both a biological parent and an adoptive parent who were greater predictive effect on future criminality of offspring than did the criminality of adoptive parents. Still, the last conclusion, these findings support the major contents of this book’s authors in the sense that they fully back up the nature–nurture argument: as opposed to the nature–versus–nurture argument. They support the idea that both biological and environmental factors contribute to the future criminality of youths.

Unfortunately, the researchers who performed these studies focused on the other two groups of youths, those who had either only criminal biological parents or only criminal adoptive parents. Thus, these adoption studies importing criminal compared to the youths who had only adoptive parents who were criminal. Obviously, this finding supports the idea that genetic influence predisposes people toward criminality. However, this methodology was subject to criticism.

Perhaps the most notable criticism of adoption studies was that adoption agencies typically incorporated a policy of selective placement, in which adoptees were placed with adoptive families similar in terms of demographics and background to their biological parents. Such selective placement could bias the results of adoption studies. However, recent analyses have examined the impact of such bias, concluding that, even after accounting for the influence of selective placement, the ultimate findings of the adoption studies are still somewhat valid. Children's biological parents likely have more influence on their future criminality than the adoptive parents who raise them from infancy to adulthood. Still, the criticism of selective placement was strong enough to encourage a fourth wave of research in the nature-versus-nurture debate, which became studies on identical twins separated at birth.

Twins Separated at Birth

Until recently, studies of identical twins separated at birth were virtually impossible because it was so difficult to get a high number of identical twins who had indeed been separated early. But, since the early 1990s, twins-separated-at-birth studies have been possible. Researchers should keep in mind that, in many of the identical twin pairs studied for these investigations, the individuals did not even know they had a twin. Furthermore, the environments in which they were raised were often extremely different; one twin might be raised by a very poor family in an urban environment while the other twin was raised by a middle-class family in a rural environment.

These studies, the most notable of which was done at the University of Minnesota, found that the twin pairs often showed extremely similar tendencies for criminality, sometimes more similar than those seen in concordance rates for identical twins raised together. This finding obviously supports the profound influence of genetics and heredity, which is not surprising to most well-read scientists, who now acknowledge the extreme importance of inheritance of psychological and physiological aspects to human behavior. Perhaps more surprising was why separated identical twins, who had never known that they had a twin and were often raised in extremely different circumstances, had just as high or even higher concordance rates than identical twins who were raised together.

The leading theory for this phenomenon is that identical twins who are raised together actually go out of their way to deviate from their natural tendencies to form an identity separate from their identical twin with whom they have spent their entire lives. As for criticisms of this methodology, none have been presented in the scientific literature. Thus, it is somewhat undisputed at this point that the identical twins-separated-at-birth studies have shown that genetics has a significant impact on human behavior, especially regarding criminal activity.

Ultimately, taking all of the nature-versus-nurture methodological approaches and subsequent findings together, the best conclusion that can be made is that genetics and heredity both have significant impacts on criminality. Environment simply cannot account for all of the consistent results seen in the comparisons between identical twins and fraternal twins, those of identical twins separated at birth, and those of adoptees with criminal biological parents versus those who did not have such parents. Despite the taboo nature of and controversial response to the findings of such studies, it is quite clear that when nature and nurture are compared, biological rather than environmental factors tend to have the most influence on the criminality of individuals. Still, the authors of this book hope that readers will emphasize the importance of the interaction between nature and nurture (better stated as nature via nurture). Ultimately, we hope that we have shown quite convincingly through scientific study that it is the interplay between biology and the environment that is most important in determining human behavior.

Perhaps in response to this nature-versus-nurture debate, a new theoretical perspective was offered in the mid-1990s that merged biological and psychological factors in explaining criminality. Although it leaned more toward the nature side of the debate, critics would use this same perspective to promote the nurture side, so this framework was useful in promoting the interaction between biology and sociological factors.
Cytogenetic Studies: The XYY Factor

Beyond the body type theories, another model was proposed in the early 1900s regarding biological conditions that predispose individuals toward crime: cytogenetic studies. Cytogenetic studies of crime focus on the genetic makeup of individuals, with a specific focus on abnormalities in chromosomal makeup, and specifically chromosomal abnormalities that occur randomly in the population. Many of the chromosomal mutations that have been studied (such as XYY) typically result from heredity but from random mutations in chromosomal formation.

The normal chromosomal makeup for women is XX, which represents an X from the mother and an X from the father. The normal chromosomal makeup for men is XY, which represents an X from the mother and a Y from the father. However, in many species of animals, there are often genetic mutations, which we see in human beings. Consistent with evolutionary theory, virtually all possible variations of chromosomes that are possible have been found in the human population, such as XXY, XYY, and many others. We will focus our discussion on the chromosomal mutations that have been most strongly linked to criminality.

One of the first chromosomal mutations recognized as a predictor of criminal activity was XYY. In 1965, the first major study showed that this mutation was far more common in a Scottish male population of mental patients than in the general population. Specifically, in the general population, XYY occurs in about 1 of every 1,000 males. The first major study that examined the influence of XYY sampled about 200 men in the mental hospital; one occurrence would have been predicted, assuming what was known about the general population. The study, however, found 13 individuals who were XYY, which suggested that individuals who have mental disorders are more likely to have XYY than those who do not. Males who have XYY have at least 13 times the likelihood (or a 1,300% chance) of studies have not been able to dismiss the effect of XYY on criminality, but they have concluded that this mutation is more often linked with property crime than with violent crime.

Would knowing this relationship help in policies regarding crime? Probably not, considering that the fact that 90% of the male mental patients were not XYY. Still, this study showed the importance of looking at chromosomal behavior as a predictor of criminal behavior.

Such mutations include numerous chromosomal abnormalities, such as XYY, which is a male who is given an extra Y chromosome, making him more "mal mAdapter." These individuals are often very tall but slow in terms of social and intelligence skills. Another type of mutation is XXY, which is otherwise known as Klinefelter’s syndrome. These two Y chromosomes has been linked to this mutation. Many other types of mutations and of individuals in each of these groups of chromosomal mutations (see Figure 5.1). This study found that the higher the level of male hormones produced by this chromosomal mutation, the lower the likelihood that the individuals would commit criminal activity. Ultimately, all of these variations in chromosomes show that there is a continuum of femininity and masculinity, and that the more maladaptive the individual is in terms of chromosomes, the more likely he is to commit criminal activity.

Ultimately, the cytogenetic studies showed that somewhat random abnormalities in an individual’s genetic makeup can have a profound influence on her or his level of criminality. Whether or not this can or should be used in policy related to crime is another matter, but the point is that genetics does indeed contribute to a disposition to commit criminal acts. The extent to which male hormones or androgens are increased by the mutation is an important predictor of criminal traits.

Hormones and Neurotransmitters: Chemicals That Determine Criminal Behavior

Various chemicals in the brain and the rest of the body determine how we think, perceive, and react to various stimuli. Hormones, such as testosterone and estrogen, carry chemical signals to the body as they are released from

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Figure 5.1: Hypothetical scattergram relating masculinity/androgen level (designated by karyotype) to deviance.

- High
- Ks (XY)
- CAH (XX)
- NM (XY)
- NPH (XX)
- TS (XO)
- AIS (XY)

Low
Masculinity/Androgen Level

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References:
- Klinefelter's syndrome.
- AIS = androgen insensitivity syndrome.
- NF = normal female.
- KS = Klinefelter's syndrome.
- CAH = congenital adrenal hyperplasia.
- NM = normal male.
- XYY = Jacobs (supermale) syndrome.

The lower the likelihood that the individuals would commit criminal activity. Ultimately, all of these variations in chromosomes show that there is a continuum of feminality and masculinity, and that the more maladapted the individual is in terms of chromosomes, the more likely he is to commit criminal activity.

Ultimately, the cytogenetic studies showed that somewhat random abnormalities in an individual's genetic makeup can have a profound influence on her or his level of criminality. Whether or not this can or should be used in policy related to crime is another matter, but the point is that genetics does indeed contribute to a disposition to commit criminal acts. The extent to which male hormones or androgens are increased by the mutation is an important predictor of criminal traits.
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Ultimately, hormones have a profound effect on how individuals think and perceive their environments. All criminal behavior comes down to cognitive decisions in our 3-pound brains. So, it should not be surprising that hormones play a highly active role in this decision-making process. Nevertheless, hormones are probably secondary compared to levels of neurotransmitters, which are chemicals in the brain and body that help transmit electric signals from one neuron to another.

Neurotransmitters can be distinguished from hormones in the sense that hormones carry a signal that is not electric, whereas the signals that neurotransmitters carry are indeed electric. Neurotransmitters are chemicals that are released when a neuron, the basic unit of the nervous system, wants to send an electric message to a neighboring neuron(s). Sending such a message requires the creation of neural pathways, which means that neurotransmitters must be activated in processing the signal. At any given moment, healthy levels of various neurotransmitters are needed to pass messages from one neuron to the next across gaps between them, called synapses.

Although there are many types of neurotransmitters, the most studied in relation to criminal activity are dopamine and serotonin. Dopamine is most commonly linked to feeling good. For example, dopamine is the chemical that tells us when we are experiencing good sensations, such as good food, sex, and so on. Most illicit drugs elicit a pleasurable sensation by enhancing the levels of dopamine in our systems. Cocaine and cathempthamine, for example, tell the body to produce more dopamine and inhibit the enzymes that typically mop up the dopamine in our systems after it is used.

Although a number of studies show that low levels of dopamine are linked to high rates of criminality, other studies show no association with—or even a positive link to—criminal behavior. However, the relationship between dopamine and criminal behavior is probably curvilinear, such that both extremely high and extremely low levels of dopamine are associated with deviance. Unfortunately, no conclusion can be made at this point due to the lack of scientific evidence regarding this chemical.

On the other hand, a clear conclusion can be made about the other major neurotransmitter that has implicated in criminal offending: serotonin. Studies have consistently shown that low levels of serotonin are linked with criminal offending. Serotonin is important in virtually all information processing, whether it is learning or

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**Reference Notes**


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**Image 5.2** Neurons are the basic cell in our nervous system, and they communicate via chemicals called neurotransmitters that aid in sending electric messages across gaps between nerve cells. Source: [http://en.wikipedia.org/wiki/Chemical_synapse#/media/File](http://en.wikipedia.org/wiki/Chemical_synapse#/media/File)
Brain Injuries

Another area of physiological problems associated with criminal activity is that of trauma to the brain. As mentioned before, the brain weighs only 3 pounds, but it is responsible for every criminal act that an individual commits, so any problems related to this structure have profound implications regarding behavior, especially deviance and criminal activity.

Studies have consistently shown that damage to any part of the brain increases the risk of crime by that individual in the future. However, trauma to certain portions of the brain tends to have more serious consequences than injury to other areas. Specifically, damage to the frontal or temporal lobes (particularly those on the left side) appears to have the most consistent associations with criminal offending.22 These findings make sense primarily because the frontal lobes (which include the prefrontal cortex) are the areas of the brain where the realm of higher-level problem solving and "executive" functioning takes place.23 Thus, the frontal lobes, especially on the left side, process what we are thinking and inhibit us from doing what we are emotionally charged to do. Thus, any moral reasoning relies on this executive area of the brain because it is the region that considers long-term consequences.24 If people suffer damage to their frontal lobes, they will be far more inclined to act on their emotional urges because they are not receiving any logical inhibitions from this specialized region.

In a similar vein, the temporal lobe region is highly related to memory and emotion. To clarify, the temporal lobes cover and communicate almost directly with certain structures of our brain's limbic systems. Certain limbic structures govern our memories (the hippocampus) and emotions (the amygdala). Any damage to the temporal lobes, which is generally located above the ear, is likely to damage these structures or the effective communication of these structures to other portions of the brain. Therefore, it is understandable why trauma to the temporal region of the brain is linked to future criminality.

Central and Autonomic Nervous System Activity

The brain is a key player in two different types of neurological systems that have been linked to criminal activity. The first is the central nervous system (CNS), which involves our brains and spinal columns and governs our voluntary motor activities. For example, the fact that you are reading this sentence means that you are in control of this brain-processing activity. Empirical studies of the influence of CNS functioning on criminality have traditionally focused on brain wave patterns, most using electroencephalograms (EEGs). Although EEGs do not do a good job of describing which areas of the brain are active or inactive, they do reveal how much the brain as an entire organ is performing at certain times.

Studies have compared brain wave patterns of known chronic offenders (e.g., psychopaths, repeat violent offenders) to those of "normal" people (i.e., those who have never been charged with a crime).25 These studies consistently show that the brain wave patterns of chronic offenders are abnormal compared to those of the normal population, with most studies showing slower brain wave patterns in psychopaths.26 Four types of brain wave patterns are found, from slowest to fastest: delta, theta, alpha, and beta.27 Delta waves are often seen when people sleep, whereas theta waves are typically observed in lower levels of wakefulness, such as drowsiness. Alpha waves (which tend to be divided into slow and fast wave patterns, as are beta waves) are usually related to a more relaxed wakefulness, and beta waves are observed with high levels of wakefulness, such as in times of extreme alertness and particularly in times of excited activity.

The studies that have compared brain wave patterns among chronic offenders and normals have shown significant differences. Psychopaths tend to have more activity in the theta and sometimes alpha patterns, whereas normals tend to show more activity in the fast alpha or beta waves. These consistent findings reveal that the cortical arousal of chronic offenders tends to be significantly slower than that of people who do not typically commit crimes. Thus, it is likely that chronic offenders typically do not have the mental functioning that would dispose them toward accurate assessments regarding the consequences of committing criminal behavior.

The second area of the nervous system that has been most linked to criminal behavior is the autonomic nervous system (ANS), which is primarily responsible for involuntary motor activities, such as heart rate, dilation of pupils, and electric conductivity in the skin. This is the type of physiological activity that is measured by polygraph measures, or lie detector tests. Such measures capitalize on the inability of individuals to control physiological responses to anxiety, which occurs in most normal persons when they lie, especially regarding illegal behavior. However, such measures are not infallible because the individuals who are most at risk of being serious, violent offenders are the most likely to pass such tests even when they are lying.


"For further discussion and explanation, see Raine, Psychophysiology of Crime, 174–77.
Figure 5.2 CNS and ANS

Consistent with the findings regarding CNS arousal levels, studies have consistently shown that individuals who have significantly lower levels of ANS functioning are far more likely to commit criminal acts. For example, studies consistently show that chronic violent offenders tend to have much slower resting heartbeats than normal people, with about as many studies estimating this difference to be as much as 10 beats per minute slower for the offenders.28


This is a highly significant gap that cannot be explained away by alternative theories—for example, the explanation that offenders are just less excited in laboratory tests.

Furthermore, people who have such low levels of CNS arousal tend to experience what is known in the psychological literature as stimulus hunger. Stimulus hunger means that individuals with such a low level of CNS arousal may constantly seek out experiences and stimuli that are risky and thus often illegal. Readers may recall that offenders have known who can never seem to get enough attention, with some even seeming to enjoy being spanked or other forms of harsh punishment. In addition, people with a low level of CNS arousal may feel no anxiety about punishment, even corporal punishment, and thus they may not adequately learn right from wrong through normal forms of discipline. This is perhaps one of the reasons why children who are diagnosed with attention deficit hyperactivity disorder (ADHD) have a higher likelihood of becoming criminals than their peers.

Because people who are accurately diagnosed with ADHD have an neurological abnormality—a significantly low functioning CNS level of arousal—doctors prescribe stimulants (e.g., Ritalin) for such youths. It may seem counter-intuitive to prescribe a hyperactive person a stimulant; however, the medication boosts the individual's CNS functioning to a normal level of arousal. This makes such individuals experience a healthy level of anxiety, which they would not normally experience from wrongdoing. Assuming that the medication is properly prescribed and at the correct dosage, children who are treated tend to become more attuned to the discipline that they face if they engage in rule violation.

Children who do not fear punishment at all—in fact, some of them do not feel anxiety even when being physically punished (e.g., spanking)—are likely to have lower than average levels of CNS functioning. Such individuals are likely to become chronic offenders if this disorder is not addressed, because they will not respond to discipline or consider the long-term consequences of their risky behavior. If people don't fear punishment or negative consequences from their behavior, they may be more likely to engage in selfish, greedy behavior. Thus, it is important to address this issue when it becomes evident. On the other hand, children will be children, and ADHD and other disorders have been overly diagnosed in recent years. A well-trained physician should investigate thoroughly to decide whether an individual has such a low level of CNS functioning that medication or therapy is required to curb deviant behavior.

Individuals who have significantly lower CNS arousal are likely to pass lie detector tests because they feel virtually no or little anxiety when they lie; many of them lie all the time. Thus, it is ironic, but the very people whom lie-detecting measures are meant to capture are the most likely to pass such tests, which is probably why they are typically not allowed to be used in court. Only through medication or cognitive behavioral therapy can such individuals learn to consider the long-term consequences of the decisions they make regarding their behavior.

Individuals with low levels of CNS functioning are not always destined to become chronic offenders. Some evidence has shown that people with low CNS arousal often become successful corporate executives, decorated military soldiers, world-champion athletes, and high-level politicians. Most of these occupations require people who constantly seek out exciting, risky behaviors, and others require constant and convincing forms of lying to others. So, there are many legal outlets and productive ways for people with low levels of CNS functioning to use their natural tendencies. These individuals could perhaps be steered toward such occupations and opportunities when they present themselves. This is clearly a better option than committing antisocial acts against others in society.

Ultimately, low levels of cortical arousal in both the CNS and ANS are clearly linked to a predisposition toward criminal activity. However, modern medical research and societal opportunities exist to help such individuals divert their tendencies toward more prosocial outlets.

Biosocial Approaches to Explaining Criminal Behavior

Perhaps the most important and most recent perspective of how criminality is formed is that of biosocial approaches to explaining crime. Specifically, if there is any conclusion that can be made regarding the previous theories and research in this section, it is that both genetics and environment influence behavior, particularly the interaction between the two. Even the most fundamental aspects of life can be explained by these two groups of factors.

For example, if we look at the height of individuals, we can predict with a great amount of accuracy how tall a person will be by looking at the individual's parents and other ancestors because much of height is determined by a person's genotype. However, even for something as physiological as height, the environment plays a large role. As many readers will observe, individuals who are raised in poor, underdeveloped areas (e.g., Mexico, Asia) are shorter than children raised in the United States. However, individuals who descend from parents and relatives in these underdeveloped areas but are raised in the United States tend to be just as tall (if not taller) than children born here. This is largely due to diet, which obviously is an environmental factor.

In other words, our genotype provides a certain range or window that determines the height of an individual based on ancestral factors. But, the extent to which individuals grow to the maximum or minimum, or somewhere in between, is largely dependent on what occurs in the environment as they develop. This is why biologists make a distinction between genotype, which is directly due to genetics, and phenotype, which is a manifestation of genetics interacting with the environment. The same type of biosocial effect is seen for criminal behavior.

Furthermore, over the last decades, a number of empirical investigations have examined the extent to which physiological variables interact with environmental variables, and the findings of these studies have shown consistent predictions regarding criminality. Such studies have been more accurate than those that rely on either physiological and genetic variables or environmental factors separately. For example, findings from a cohort study in Philadelphia showed that individuals who had low birth weights were more likely to commit crime, but that was true primarily if they were raised in a lower-income family or a family with a weak social structure. Those who were raised in a relatively high-income household or a strong family structure were unlikely to become criminals. It was the coupling of both a physiological deficiency (i.e., low birth weight) and an environmental deficit (i.e., weak family structure or income) that had a profound effect on propensity for criminal behavior.

In addition, recent studies have shown that when incarcerated juveniles were assigned to diets with limited levels of simple carbohydrates (e.g., sugars), their reported levels of violations during incarceration declined by almost half (45%). Furthermore, other studies have reported that various food additives and dyes, such as those commonly found in processed foods, can also have a significant influence on criminal behavior. Thus, the old saying "you are what you eat" appears to have some scientific weight behind it, at least regarding criminal behavior. Additional studies have found that high levels of certain toxins, particularly lead and manganese, can have profound effects on behavior, including criminality. Recent studies have found a consistent, strong effect of high lead levels in predicting criminal behavior. Unfortunately, medical studies have also found many subtle sources of high lead levels, such as the fake jewelry that many children wear as toys. Also unfortunate is that the individuals who are most vulnerable to high levels of lead (like virtually every other toxin) are children, and yet they are the most likely to be exposed. Even more unfortunate is that the populations most susceptible to biosocial interactions (e.g., poor, urban) are most likely to experience high levels of lead, largely due to old paint, which often contains lead, and other household products that contain dangerous toxins.

To address the growing concern of brain development in children, there are multiple studies that address the effects of global media, the Internet, and television violence on criminal propensity. Consistently, other studies have shown that prenatal and perinatal problems alone do not predict violence very well. However, when such perinatal problems are considered along with environmental deficits, such as weak family structure, this biosocial relationship often predicts violent rather than property crime. Other studies have shown the effects on criminality of a biosocial interaction between the impact of physiological factors within the first minute of life, called Appgar scores, and environmental factors, including exposure to nicotine. Additional studies have also found that the interaction between maternal cigarette smoking and the father's absence from the household is associated with criminal behavior, especially early in life, which is one of the biggest predictors of chronic offending in the future. One of the most revealing studies showed that, although only 4% of a sample of 4,269 individuals had both birth complications and maternal rejection, this relatively small group of people accounted for more than 18% of the total violent crimes committed by the whole sample. So, studies have clearly shown that the interaction between biological factors and environmental deficiencies has the most consistent effect on future criminality.

Policy Implications

The theories in this section have plenty of policy implications; a few of the primary interventions are discussed here. First, there should be universal, funded preschool for all children. This early life stage is important not only for developing academic skills, but also for fostering healthy social and disciplinary skills, which children who do not attend preschool often fail to develop. In addition, there should be funded mental health and drug counseling for all young children and adolescents who exhibit symptoms of mental disorders or drug problems. There should also be universal funding for health care for all expectant mothers, especially those who have risk factors (poverty, etc.)

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11Ibid., pp. 57–58.
inner-city residence, etc.). Also, and perhaps most important, there should be far more thorough examinations of children’s physiological makeup in terms of hormones, neurotransmitters, brain formation and functioning, and genetic design so that earlier interventions can take place. It has been shown empirically that the earlier that intervention takes place, the better the outcomes. These and other policy implications based on modern biosocial theories will be discussed in the final section of the book.

**Conclusion**

This section has examined a large range of explanations of criminal behavior that place most of the blame on biological and psychological factors, which are typically intertwined. These types of explanations were primarily popular in the early years of the development of criminology as a science, but they have also been shown in recent years to be quite valid as significant factors in individual decisions to commit crime. This section examined the influence of genetics and environment in family studies, twins studies, adoption studies, and studies of identical twins separated at birth. These studies have ultimately shown the consistent influence of inheritance and genetics in predisposing individuals toward criminal activity. This is supported by the influence of hormones (e.g., testosterone) in human behavior, as well as the influence of variations in chromosomal mutations (e.g., XY). Recent research has supported both of these theories in showing that people with high levels of male androgens are far more likely to commit crimes than those who do not have high levels of these hormones.

The link between brain trauma and crime was also discussed, with an emphasis on the consistent association between damage to the left or frontal parts of the brain. We also examined theories regarding variations in levels of CNS and ANS functioning; all empirical studies have shown that low levels of functioning of these systems have links to criminality. Finally, we explored the extent to which the interaction between physiological factors and environmental variables contributes to the most consistent prediction of criminal offending. Ultimately, it is interesting that the very theories that were key in the early years of the development of criminology as a science are now showing strong support in studies for being primary influences on criminal behavior.

**Section Summary**

- Early studies that examined the influence of biology focused on case studies of certain families. These studies showed that criminality was indeed clustered among certain families, but such studies did not separate biology from environment.
- The next stage of studies examined the concordance rates of identical twins versus nonidentical twins. These studies led to the conclusion that genetic makeup was very important, but critics called these conclusions into question.
- The following stage of research examined adoptees to determine which parents (biological or adoptive) had more influence in their future criminal behavior. These studies revealed that biological parents (whom the adoptees never knew) had far more influence than the adoptive parents who raised them. However, there were criticisms of these studies, so the findings were questioned.
- The final stage of the biology-versus-environment debate was that of identical twins separated at birth as compared to identical twins raised together. These studies showed that the twins who were separated at birth were just as similar, if not more so, than the twins who were reared together. To date, there are no criticisms of this evidence that are vitally important in explaining the criminality of individuals.

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**KEY TERMS**

- adoption studies
- dopamine
- selective placement
- autonomous nervous system (ANS)
- family studies
- seratonin
- central nervous system (CNS)
- frontal lobes
- monozygotic twins
- concordance rates
- monozygotic twins
- cytogentic studies
- neurotransmitters
- dizygotic twins
- phenotype
- twins-separated-at-birth studies
- twin studies

**DISCUSSION QUESTIONS**

1. Is there any validity to family studies in determining the role of genetics in criminal behavior? Explain why or why not.
2. Explain the rationale of studies that compare the concordance rates of identical twins and fraternal twins who are raised together. What do most of these studies show regarding the influence of genetics on criminal behavior? What are the criticisms of these studies?
3. Explain the rationale of studies that examine the biological and adoptive parents of adopted children. What do most of these studies show regarding the influence of genetics on criminal behavior? What are the criticisms of these studies?
4. What are the general findings in identical twins who are separated at birth? What implications do those findings have for the importance of genetics or heritability regarding criminal behavior? Can you find a criticism for such findings?
5. Explain what cytogentic disorders are and describe the related disorder that is most linked to criminal behavior. What characteristics of this type of disorder seem to drive the higher propensity for criminal behavior?
6. What types of hormones have been shown by scientific studies to be linked to criminal activity? Give specific examples that show this link to be true.
2. Explain what neurotransmitters are, and describe which neurotransmitters are key in predicting criminal offending. Provide support from previous scientific studies.

3. Which areas of the brain, given trauma, have shown the greatest vulnerability regarding criminal offending? Does the lack of healthy functioning in these areas make sense? Why?

4. How do brain wave patterns differ between chronic, violent criminals and "normal" people? Does this make sense in biosocial models of criminality?

5. How does the ANS differ between chronic, violent criminals and "normal" people? Does this make sense in biosocial models of criminality?

6. What types of policy implications would you support based on the information provided by empirical studies reviewed in this section?

WEB RESOURCES

ANS/CNS
http://www.crimetimes.org/
http://www.mentalhelp.net/poc/view_doc.php?type=doc&id=263

Brain Trauma and Crime
http://www.crimetimes.org/

Cytogenetic Studies
http://en.wikipedia.org/wiki/cytogenetics

Family/Twin/Adoption Studies
http://www.bookrags.com/research/twin-studies-wog/
http://www.criminology.fsu.edu/crimtheor/dugdal.htm

Hormones and Neurotransmitters
http://serendip.brynmawr.edu/biology/2103/02/web1/kamlin.html
http://www.gender.org.uk/about/06encrem/06faggrs.htm

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READING 10

A Theory Explaining Biological Correlates of Criminality
Lee Ellis

Despite growing evidence that biology plays an important role in human behavior, most theories of criminal behavior continue to focus on learning and social environmental variables. This article proposes a biosocial theory of criminality that leads one to expect variables such as age, gender and social status will be associated with offending in very specific ways. According to the theory, androgens (male sex hormones) have the ability to affect the brain in ways that increase the probability of what is termed competitive/victimizing behavior (CVB). This behavior is hypothesized to exist along a continuum, with "crude" (criminal) forms at one end and "sophisticated" (commercial) forms at the other. Theorically, individuals whose brains receive a great deal of androgen exposure will be prone toward CVB. However, if they have normal or high capabilities to learn and plan, they will transition rapidly from criminal to non-criminal forms of the behavior following the onset of puberty. Individuals with high androgen exposure and poor learning and planning capabilities, on the other hand, often continue to exhibit criminality for decades following the onset of puberty.

The Evolutionary Neuroandrogenic Theory of Criminal Behavior

The theory to be presented is called the evolutionary neuroandrogenic theory (ENA). The main types of offenses it attempts to explain are those that harm others, either by injuring them physically or by depriving them of their property. Two main propositions lie at the heart of ENA theory. The first addresses evolutionary issues by asserting that the commission of victimful crimes evolved as an aspect of human reproduction, especially among males. The second is concerned with identifying the neurochemistry responsible for increasing the probability of criminality among males relative to females. The theory maintains that sex hormones alter male brain functioning in ways that promote CVB, which is hypothesized to include the commission of violent and property crimes.

The concept of CVB is illustrated in Table 1. At one end of the continuum are acts that intentionally and directly either injure others or dispossess them of their property.

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