In February of 1991, Stephen Mobley walked into a Domino's Pizza store in Georgia to rob it. Once he got the money, Mobley forced store manager John Collins onto his knees and shot him execution style. In the automatic appeal to the Georgia Supreme Court to get his sentenced commuted to life in prison, his primary defense boiled down to claiming that “my genes made me do it.” In support of this defense, Mobley’s lawyers pointed to a Dutch study of an extended family in which for generations many of the men had histories of unprovoked violence. The researchers took DNA samples from 24 male members of the family and found that those with violent records had a marker for a mutant or variation of a gene for the manufacture of monoamine oxydase A (MAOA), an enzyme that regulates a lot of brain chemicals. Mobley’s lawyers found a similar pattern of violent behavior and criminal convictions among his male relatives across the generations and requested funds from the court to conduct genetic tests on Mobley to see if he had the same genetic variant.

The court wisely denied the defense motion. Even if it were found that Mobley had the same genetic variant, it would not show that he lacked the substantial capacity to appreciate the wrongfulness of his acts or to conform to the requirements of the law. Mobley’s lawyers were hoping to mitigate his sentence by appealing to a sort of genetic determinism that simply does not exist. As we shall see in this section, genes don’t “make” us do anything; they simply bias us in one direction rather than another. Except in cases of extreme mental disease or defect, we are always legally and morally responsible for our behavior. Cases such as Mobley’s underline the urgent need for criminologists to understand the role of genes in human behavior as that role is understood by geneticists.
The Biosocial Approach

Biosocial theories have not been popular with mainstream social scientists until fairly recently because they were interpreted as a sort of “biological determinism.” This kind of thinking is rarer today as social scientists have become more sophisticated in their thinking about the interaction of biology and the environment (M. Robinson, 2004). There are still people who fear that “biological” theories can be used for racist ends, but as Bryan Vila (1994) remarks, “Findings can be used for racist or eugenic ends only if we allow perpetuation of the ignorance that underlies these arguments” (p. 329). Bigots and hate mongers will climb aboard any vehicle that gives their prejudices a free ride, and they have done so for centuries before genes were heard of.

Biosocial criminologists believe that because humans have brains, genes, hormones, and an evolutionary history, they should integrate insights from the disciplines that study these things into their theories and dismiss naïve nature versus nurture arguments in favor of nature via nurture. Any trait, characteristic, or behavior of any living thing is always the result of biological factors interacting with environmental factors (Cartwright, 2000), which is why we call modern biologically informed criminology biosocial rather than biological. In many ways, the early positivists were biosocial in approach because they explicitly envisioned biological and environmental interaction. Their ideas and methods were primitive by today’s standards, but then, so were the ideas and methods of most sciences in the 19th century. Evolutionary ideas about the behavior of all animals (especially the human animal) were poorly understood; genes were unheard of, and the brain was still a mysterious locked black box. This has all changed with the sequencing of the human genome and with the advent of machines that enable us to see what is going on in the brain as we think and act. For these and other reasons, biosocial research into criminality is proceeding at an explosive pace. As Lilly et al. (2007) maintain, “It is clear that the time has arrived for criminologists to abandon their ideological distaste for biological theories” (p. 304).

Behavior Genetics

Behavior genetics is a branch of genetics that studies the relative contributions of heredity and environment to behavioral and personality characteristics. Genes and environments work together to develop all the traits—height, weight, IQ, impulsiveness, blood sugar levels, blood pressure, and so on—the sum of which constitutes the person.

Behavior geneticists stress that genes do not cause us to behave or feel; they simply facilitate tendencies or dispositions to respond to environments in one way rather than in another. There are no genes “for” criminal behavior, but there are genes that lead to particular traits such as low empathy, low IQ, and impulsiveness that increase the probability of criminal behavior when combined with the right environments.

Geneticists use twin and adoption studies to disentangle the relative influences of genes and environments, and they tell us that genes and environments are always jointly responsible for any human characteristic. To ask whether genes or environment is most important for a given trait is just as nonsensical as asking whether height or width is most important to the area of a rectangle. Gene expression always depends on the environment (think of identical rose seeds planted in an English garden and in the Nevada desert, and then think about where the full genetic potential of the seeds will be realized).

Behavior geneticists quantify the extent to which genes influence a trait with a measure called heritability (symbolized as $h^2$), which ranges between 0 and 1. The closer $h^2$ is to 1.0, the more of the variance (difference) in a trait in a population, not in an individual, is due to genetic factors. Since any
differences among individuals can only come from two sources—genes or environment—heritability is also a measure of environmental effects \((1 - h^2) = \text{environmental effects}\). All cognitive, behavioral, and personality traits are heritable to some degree, with the traits discussed in the psychosocial section being in the .30 to .80 range (Carey, 2003).

**Gene–Environment Interaction and Correlation**

Gene–environment interaction and gene–environment correlation describe people's active transactions with their environment. **Gene–environment interaction (GxE)** involves the common-sense notion that people are differentially sensitive to identical environmental influences and will thus respond in different ways to them. For instance, a relatively fearless and impulsive person is more likely to seize opportunities to engage in antisocial behavior than is a fearful and constrained person.

**Gene–environment correlation (rGE)** means that genotypes and environments are related. All living things are designed to be responsive to their environments, and GxE and rGE help us to understand how by showing the indirect way that genes help to determine what aspects of the environment will and will not be important to us. In addition to furthering our understanding of the role of genes, advances in genetics have yielded enormous benefits to our understanding of the environment's role in shaping behavior; as Baker, Bezdjian, and Raine (2006) put it, “the more we know about genetics of behavior, the more important the environment appears to be” (p. 44). There are three types of G–E correlation: passive, evocative, and active.

**Passive** rGE is the positive association between genes and their environments that exists because biological parents provide children with genes linked to certain traits and an environment favorable for their expression. Children born to intellectually gifted parents, for instance, are likely to receive genes that lead to above-average intelligence and an environment in which intellectual behavior is modeled and reinforced, thus setting them on a trajectory that is independent (passively) of their actions.

**Evocative** rGE refers to the way others react to the individual on the basis of his or her behavior. Children bring traits with them to situations that increase or decrease the probability of evoking certain kinds of responses from others. A pleasant and well-mannered child will evoke different reactions than will a bad-tempered and ill-mannered child. Some children may be so resistant to socialization that parents may resort to coercive parenting or simply give up, either of which may worsen any antisocial tendencies and drive them to seek environments where their behavior is accepted.

▲ **Photo 8.1** Former major league baseball player Jose Canseco is sworn in at a U.S. House of Representatives baseball steroids hearing. Canseco presents a fascinating case for biosocial theories. Jose had a fraternal twin brother, Ozzie, who also chose a career in baseball. However, in comparison with Jose’s 462 home runs and over 1,400 RBI, Ozzie had only a “cup of coffee” in the major leagues. He came to bat only 65 times over 3 seasons and never hit a home run. Had he been an identical rather than a fraternal twin, might Ozzie have performed more like his brother? After finishing his baseball career, Jose wrote a book (*Juiced*) in which he admitted using steroids for most of his playing career and claimed that 85% of other players in his era did likewise. Because of his steroid use, many baseball experts predict Jose will never be elected to the baseball Hall of Fame, though his career numbers exceed those of many current Hall of Fame players.
Evocative rGE thus serves to magnify phenotypic differences by funneling individuals into like-minded peer groups (“birds of a feather flock together”).

Active rGE refers to the active seeking of environments compatible with our genetic dispositions. Active rGE becomes more pertinent as we mature and acquire the ability to take greater control of our lives because within the range of possibilities available in our cultures, our genes help to determine what features of the environment will and will not be attractive to us. Active rGE assures us that our minds and personalities are not simply products of external forces, and that our choices are not just passive responses to social forces and situations. We are active agents who create our own environments just as they help to create us. Genes imply human self-determination because, after all, our genes are our genes. As Colin Badcock (2000) put it, “Genes don’t deny human freedom; they positively guarantee it” (p. 71). Genes are constantly at our beck and call, extracting information from the environment and manufacturing the substances we need to navigate it. They are also what make us uniquely ourselves and thus resistant to environmental influences that grate against our natures. In short, genes do not constrain us; they enable us. This view of humanity is more respectful of human dignity than the blank slate view that we are putty in the hands of the environmental winds.

Behavior Genetics and Criminal Behavior

Although there are no genetic theories of criminal behavior per se, behavior genetic studies help us to better understand traditional criminological theories. For instance, large behavior genetic studies conducted in the United States (Cleveland et al., 2000) and the UK (Moffitt & the E-Risk Study Team, 2002) have shown that genetic factors play a large part in sorting individuals into different family structures (broken vs. intact homes), a variable often linked to antisocial behavior. In both these studies, families consisting of a divorced or never-married mother with children fathered by different men are the most at-risk family type for antisocial behavior, and families with full siblings with both biological parents present were least at risk, as noted in Chapter 7. Genes, of course, contribute to the choices people make, as well as make people easy or difficult to live with.

One of those genetic factors is almost certainly low self-control. As we saw in Chapter 5, Gottfredson and Hirschi (1990) attributed low self-control exclusively to parental treatment. However, there are now well over 100 studies that have shown rather strong links between low self-control and low levels of the neurotransmitter serotonin (Crockett, Clark, Lieberman, Tabinia, & Robbins, 2010). In other words, while we all have to be taught to control our impulses, some of us are naturally easier to teach than others. Levels of serotonin are governed both by genes and by the environment. That is, genes govern the base levels of serotonin a person has, but what is going on in the environment results in serotonin levels increasing and decreasing (J. Wright, 2011).

Unlike the relatively strong genetic influences discovered for most human traits, genetic influences on antisocial behavior are modest, especially during the teenage years. A study of 3,226 twin pairs found that genes accounted for only 7% of the variance in antisocial behavior among juvenile offenders, but 43% among adult offenders (Lyons et al., 1995). Heritability coefficients for most traits related to antisocial behavior are typically in the .30 to .80 range, and for antisocial behavior itself, two meta-analyses concluded that they are in the .40 to .58 range (Ferguson, 2010; Rhee & Waldman, 2002), with $h^2$ being higher in adult than in juvenile populations. What this means is that the majority of delinquents have little if any genetic vulnerability to criminal behavior, while a small minority may have considerable vulnerability. Pooling these two groups has the effect of elevating estimates of the overall influence of genes while minimizing it
for those most seriously involved. Strong genetic effects on antisocial behavior are most likely to be found only among chronic offenders who begin offending prior to puberty and who continue to do so across the life course (Moffitt & Walsh, 2003).

Molecular Genetics

Heritability estimates only tell us that genes are contributing to a trait, but they do not tell us which genes; only molecular genetics can tell us this. Fortunately, we can now go straight to the DNA (DNA is the acid in the nucleus of our cells that contains the instructions for particular genes, which in turn directs the manufacture of the substances we all need to survive and function) by genotyping the individuals with a simple cheek swab. We can then do an analysis of the effects of certain genes on individuals who have them and compare it with people who do not. Molecular genetic studies are being conducted with increasing frequency in criminology, with the huge National Longitudinal Study of Adolescent Health (ADD Health) study being one yielding some very important genetic findings. It is important to emphasize that any individual gene accounts only for a miniscule proportion of the variance in criminal behavior, and that it contributes to a trait linked to criminality, not to criminality itself, which you remember is a composite of many different traits. Genes always have indirect effects on behavior via the effects of the proteins they make on human traits and abilities.

All people in the world have the same genes that make them human, but we all have slight variations of them that make us all different (except for identical twins). If we didn't have these differences, the police in all those crime scene investigation shows would not be able to identify suspects by the bodily fluids left behind at crime scenes. For instance, although we all have genes that make blood, we have different blood types. Differences among individuals in behavioral traits are partially the result of what geneticists call genetic polymorphisms. Polymorphisms are differences in DNA sequences that code for the same gene, but which may make more or less of the substance (say, low serotonin), which leads to slightly different functional or physical traits among individuals. Let us return to Mobley’s “my MAOA gene made me do it” argument in the opening vignette to illustrate how geneticists study the effects of these gene variants.

A major longitudinal study of maltreatment looking at the role of the MAOA gene showed why only about one half of abused/neglected children become violent adults (Caspi et al., 2002). The MAOA gene comes in variants that genetics call “high” and “low” activity. For a variety of reasons we cannot get into here, the low-activity version is a risk factor for a number of behavioral problems, and the high-activity version is a protective factor. Neither the genetic risk nor environmental risk factors by themselves had much effect on antisocial behavior. When combined, however, the odds of having a verified arrest for a violent crime for those with both genetic (the low variant of the MAOA gene) and environmental (maltreatment) risk factors were found to be 9.8 times greater than the odds for subjects with neither the genetic nor the environmental risk. Furthermore, although the low MAOA + maltreatment subjects were only 12% of the cohort, they were responsible for 44% of its criminal convictions.

The overall conclusion arrived at by a meta-analysis of the MAOA/maltreatment research was that their interaction is a significant predictor of antisocial behavior across all studies (Kim-Cohen et al., 2006). However, a study by Widom and Brzustowicz (2006) found that while the high-activity MAOA allele (an alternate form of a gene at the same location on a chromosome) buffered whites from the effects of childhood abuse and neglect as it relates to antisocial behavior later in life, it did not protect nonwhites. The authors suggest that other environmental stressors, such as the high density of antisocial others in the neighborhood, may have negated the protective power of the high-activity polymorphism among nonwhites.
in the study. These studies all point to the importance of studying GxE interactions—how the environment modifies the effects of genes, and how genes modify the effects of the environment. There are many other genetic polymorphisms related to antisocial behaviors being examined by biosocial criminologists, but we will encounter just one more in the next section.

**Evolutionary Psychology**

**Evolutionary psychology** explores human behavior using a theoretical framework and seeks to explain it with reference to human evolutionary history. Criminologists operating within the evolutionary framework explore how certain behaviors society now calls criminal may have been adaptive (such as useful in the pursuit of reproductive success, the ultimate goal of all living things) in ancestral environments. Evolutionary psychology complements genetics because it informs us how the genes of interest came to be present in the human gene pool in the first place. While genetics looks for what makes people different, evolutionary psychology focuses on what makes us all the same. Another basic difference is that evolutionary psychology looks at ultimate-level “why” questions (What evolutionary problem did this behavioral mechanism evolve to solve?), and geneticists look at proximate-level “how” questions (To what extent is this behavioral mechanism influenced by genes in this population at this time?). Ultimate causes are thus those that occurred in the past that are ultimately responsible for something, whereas a proximate cause is one that is most immediately responsible for causing some observed behavioral outcome.

Evolutionary psychologists agree with most criminologists that although it is morally regrettable, crime is normal behavior for which we all have the potential (Kanazawa, 2003). Evolutionary logic tells us that if criminal behavior is normal, it must have provided some evolutionary advantage for our distant ancestors. However, because modern environments are so radically different from the hunter/gatherer environments in which we evolved many of our most human traits, many traits selected for their adaptive value at the time may not be adaptive today. It is important to realize that it is the traits underlying criminal behavior that are the alleged adaptations, not the specific acts we call crimes (Walsh, 2009a).

Criminal behavior is a way to acquire resources illegitimately. Evolutionary psychologists refer to such behavior (whether it is defined as criminal or not) as cheating, and think of individual traits associated with it such as impulsiveness and aggression in terms of adaptive traits all humans share, but which also vary considerably among them. Whether exploitation occurs depends on environmental triggers interacting with individual differences and with environmental constraints. Although we all have the potential to exploit and deceive others, we are a highly social and cooperative species with minds forged by evolution to form cooperative relationships built on trust (Barkow, 2006). Cooperation is typically contingent on the reciprocal cooperation of others, and is thus a tit-for-tat strategy favored by natural selection because of the benefits it confers. We cooperate with our fellows because we feel good when we do, and because it identifies us as reliable and trustworthy, which confers valued social status on us.

Because cooperation occurs among groups of other cooperators, it creates niches for non-cooperators to exploit others by signaling their cooperation and then failing to follow through (Barkow, 2006). Criminal behavior may thus be viewed as an extreme form of defaulting on the rules of cooperation. But cheating comes at a cost, so before deciding to do so the individual must weigh the costs and benefits of cooperating versus defaulting. Cheating is rational (not to be confused with moral) when the benefits outweigh the costs. But if cheating is so rational, how did cooperation come to be predominant in social species? The answer is that cheating is only rational in circumstances of limited interaction and communication. Frequent interaction and communication breeds trust and bonding, and cheating
becomes a less rational strategy because cooperator remember and retaliate against those who have cheated them. Ultimately, cooperation is the most rational strategy in any social species because each player reaps in the future what he or she has sown in the past.

Yet, we continue to see cheating behavior despite threats of exposure and retaliation. We do so because exposure and retaliation are threats only if cheats must operate within the same environment in which their reputations are known. Cheats can move from location to location, meeting and cheating a series of others who are unaware of their reputation. This is the pattern of many career criminals who move from place to place, job to job, and relationship to relationship, leaving a trail of misery behind them before their reputation catches up. This is why cheats are more likely to prosper in large cities in modern societies than in small traditional communities where the threat of exposure and retaliation is great (Ellis & Walsh, 1997).

Of course, the stability of the group and cultural dynamics must be considered. In communities where a “badass” reputation is valued by males more than anything else, criminal behavior is almost a constant thing. Even in these unstable communities containing large numbers of chronic cheats, there must be a certain level of group loyalty and cooperation.

The Evolution of Criminal Traits

There are a number of evolutionary theories of crime, all of which focus on reproductive strategies. This is not surprising because from a biological point of view, the evolutionary imperative of all living things is reproductive success. There are two ways that members of any animal species can maximize reproductive success: parenting effort and mating effort. Parenting effort is the proportion of reproductive effort invested in rearing offspring, and mating effort is that proportion of effort allotted to acquiring sexual...
partners. Because humans are born more dependent than any other animal, parenting effort is particularly important to our species. The most useful traits underlying parenting effort are altruism, empathy, nurturance, and intelligence (Rowe, 2002).

Humans invest more in parenting effort than any other species, but there is considerable variation within the species. Gender constitutes the largest division due to different levels of obligatory parental investment between the genders. Female parental investment necessarily requires an enormous expenditure of time and energy, but the only obligatory investment of males is the time and energy spent copulating. Reproductive success for males increases in proportion to the number of females to whom they have sexual access, and thus males have an evolved propensity to seek multiple partners. Mating effort emphasizes quantity over quality (maximizing the number of offspring rather than nurturing a few), although maximizing offspring numbers is obviously not a conscious motive of any male seeking sex. The proximate motivation is sexual pleasure, with more offspring being a natural consequence (in pre-contraceptive days) when the strategy proved successful.

Reproductive success among our ancestral females rested primarily on their ability to secure mates to assist them in raising offspring in exchange for exclusive sexual access, and thus human females evolved a much more discriminating attitude about sexual behavior (Geary, 2000). According to evolutionary biologists, the inherent conflict between the reckless and indiscriminate male mating strategy and the careful and discriminating female mating strategy drove the evolution of traits such as aggressiveness, and the lowering of trait levels (relative to female levels) such as empathy and constraint that help males to overcome both male competitors and female reluctance. The important point to remember is that although these traits were designed by natural selection to facilitate mating effort, they are also useful in gaining non-sexual resources via illegitimate means (Quinsey, 2002; Walsh, 2006).

The reverse is also true—traits that facilitate parenting effort underlie other forms of prosocial activity: “crime can be identified with the behaviors that tend to promote mating effort and noncrime with those that tend to promote parenting effort” (Rowe, 1996, p. 270). Because female reproductive success hinges more on parenting effort than mating effort, females have evolved higher levels of the traits that facilitate it (e.g., empathy and altruism), and lower levels of traits unfavorable to it (e.g., aggressiveness) than males. Of course, both males and females engage in both mating and parenting strategies, and both genders follow a mixed mating strategy. It is only claimed that mating behavior is more typical of males and parenting effort is more typical of females.

Empirical research supports the notion that an excessive concentration on mating effort is linked to criminal behavior. A review of 51 studies relating number of sex partners to criminal behavior found 50 of them to be positive, and in another review of 31 studies it was found that age of onset of sexual behavior was negatively related to criminal behavior (the earlier the age of onset, the greater the criminal activity) in all 31 (Ellis & Walsh, 2000). A British cohort study found that the most antisocial 10% of males in the cohort fathered 27% of the children (Jaffee, Moffitt, Caspi, & Taylor, 2003), and anthropologists tell us that there are striking differences in behavior between members of cultures that emphasize either parenting or mating strategies. Cultures emphasizing mating effort the world over exhibit behaviors (low-level parental care, hyper-masculinity, transient bonding) considered antisocial in Western societies (Ember & Ember, 1998).

Molecular genetic studies also find significant relationships between sexual and criminal behavior. A study by Beaver, Wright, and Walsh (2008) tested the evolutionary claim that the most antisocial individuals should have the largest number of sexual partners. They found that the same polymorphism of the dopamine (a neurotransmitter discussed in the next section) transporter gene (DAT1) that was
significantly related to number of sexual partners was also significantly related to antisocial behavior. The reason for this is that one variant of the DAT1 gene is exceptionally efficient at clearing dopamine from the synaptic gap (see below) after it signals other neurons. This is problematic because it is dopamine that gives us pleasure when we engage in activities such as having sex, so if it is cleared too fast we are moved to seek more of the activity to get more pleasure (more dopamine). This constant seeking of activities to raise dopamine levels is the chemical basis of addiction to all sorts of things besides sex (drugs, smoking, food, gambling, alcohol, and so forth). The researchers found a positive association between number of sex partners and antisocial behavior, and that variation in the DAT1 gene explains variation in both number of sexual partners and in criminal conduct for males. Another study of 674 males found that males who had two copies (one each from their mother and father) of the same DAT1 polymorphism had significantly more sex partners (an average of 5.66) than males who had only one or no copies (an average of 2.94), as well as significantly higher delinquency scores and scores on other kinds of risky behaviors (Guo, Tong, & Cai, 2008). In other words, this particular gene variant is typically found among “people who need high levels of excitement and stimulation to activate their reward system in the same capacity as those with normally functioning reward systems” (DeLisi, Beaver, Vaughn, & Wright, 2009, p. 1189).

The Neurosciences

Whether the source of human behavior is internal or external, it is necessarily funneled through the brain, arguably the most awe-inspiring structure in the universe. Although the brain is only about 2% of body mass, it consumes 20% of the body’s energy as it perceives, evaluates, and responds to its environment (Shore, 1997). This 3-pound marvel of evolutionary design is the CEO of all that we think, feel, and do. Powerful brain imaging technologies such as PET, MRI, and fMRI scans have resulted in an explosion of information on the brain over the past two decades. We are a long way from fully understanding the brain, but we cannot ignore the things known about it that are relevant to criminology. Matthew Robinson (2004) goes as far as to say that any theory of behavior “is logically incomplete if it does not discuss the role of the brain” (p. 72). As we will see, the insights criminologists can derive from neuroscience will not only buttress our theories but may also strengthen our claims for preventative environmental intervention.

Softwiring the Brain by Experience

All our thoughts, feelings, emotions, and behaviors are the results of networks of billions of brain cells called neurons communicating with one another through substances called neurotransmitters. There are many transmitters and other brain chemicals, but criminologists are most interested in dopamine and serotonin. Figure 8.1 shows how neurotransmitters shunt information back

Photo 8.3  Harkening back to the 19th century, when postmortem examinations of the brains of criminals were a frequent phenomenon, the brain of serial killer John Wayne Gacy was dissected after his execution. The attempt to locate an organic explanation of his monstrous behavior was unsuccessful.
Information from the environment is received from thousands of dendrites (the little finger-like projections in the figure), summated in the body of the neuron, and passed on electrically down the axon (the longer projection from the neuron in the figure). When the impulse reaches the end of the axon, it releases the neurotransmitters across the synaptic gap to further relay the message. The most important thing to remember here is that more “primitive” networks that control vital functions such as breathing and heart rate come “hardwired” at birth, but development of the higher brain areas depends a lot on environmental “software” downloaded after birth. The message neuroscience has for us is that the experiences we encounter largely determine the patterns of our neuronal connections, and thus our ability to successfully navigate our lives (Quartz & Sejnowski, 1997).

**Figure 8.1 Neurons, Axons, Dendrites, and the Synaptic Process**

Neural networks are continually being made and selected for retention or elimination in a “use it or lose it” process governed by the strength and frequency of experience. Retention is biased in favor of networks that are most stimulated during early development (Restak, 2001). This is why bonding and attachment are so vital to human beings, and why abuse and neglect are so injurious. Hormones released by chronic stress can cause neurons to die, and children with high levels of these hormones experience cognitive and social development delays (M. Robinson, 2004). As Perry and Pollard (1998) point out, “Experience in adults alters the organized brain, but in infants and children it organizes the developing brain” (p. 36). Brains organized by stressful and traumatic events tend to relay events along the same brain pathways laid out by early events because pathways laid down early in life are more resistant to elimination than pathways laid down later in life. A brain organized by negative events is ripe for antisocial behavior.

**Reward Dominance and Prefrontal Dysfunction Theories**

If social animals are to function normally in their social groups, they must possess the ability to respond to signals of reward and punishment with socially appropriate approach and avoidance behavior. Reward dominance theory is a neurological theory based on the proposition that behavior is regulated by two opposing mechanisms, the behavioral activating (or approach) system (BAS) and the behavioral inhibition system (BIS). The BAS is associated with the neurotransmitter dopamine and with pleasure areas in the brain (Gove & Wilmoth, 2003). The BIS is associated with serotonin and with brain structures that govern memory. Neurotransmitters such as dopamine and serotonin are the chemical messengers that shunt information between neural networks. Dopamine facilitates goal-directed behavior, and serotonin generally modulates behavior (Depue & Collins, 1999).

The BAS is sensitive to reward and can be likened to an accelerator motivating a person to seek rewarding stimuli. The BIS is sensitive to threats of punishment and can be likened to a brake that stops a person from going too far too fast. The BAS motivates us to seek whatever affords us pleasure, and the BIS tells us when we have had enough for our own good. A normal BAS combined with a faulty BIS, or vice versa, may lead to a very impulsive person with a “craving brain” that can lead him or her into all sorts of physical, social, moral, and legal difficulties, by becoming addicted to pleasures such as food, gambling, sex, alcohol, and drugs (Day & Carelli, 2007).

While most of us are more or less equally sensitive to both reward and punishment (BAS/BIS balance), in some people one system might dominate the other most of the time. The theory asserts that criminals, especially chronic criminals, have a dominant BAS, which tends to make them overly sensitive to reward cues and relatively insensitive to punishment cues (Day & Carelli, 2007). Reward dominance theory provides us with hard physical evidence relating to the concepts of sensation seeking, impulsiveness, and low self-control we have previously discussed, since each of these traits is undergirded by either a sticky accelerator (not enough dopamine) or faulty brakes (low serotonin).

A third system of behavior control is the fight or flight system (FFS), chemically controlled by the adrenal hormone and neurotransmitter epinephrine (adrenaline). The FFS is that part of the autonomic nervous system that mobilizes the body for vigorous action in response to threats by pumping out epinephrine. Fear and anxiety at the chemical level are epinephrine shouting its warning: “Attention, danger ahead; take action to avoid!” Having a weak FFS that whispers rather than shouts combined with a BAS that keeps shouting, “Go get it!” and a BIS too feeble to object, is obviously very useful when pursuing all kinds of antisocial activities.

Another neurologically specific theory of criminal behavior is prefrontal dysfunction theory. The prefrontal cortex (PFC) is a part of the brain located just above the eyes that occupies about one third of the human cerebral cortex, and has been called “the most uniquely human of all brain structures” (Goldberg, 2001, p. 2).
The PFC is responsible for a number of things such as making moral judgments, planning, analyzing, synthesizing, and modulating emotions. The PFC provides us with knowledge about how other people see and think about us, thus moving us to adjust our behavior to consider their needs, concerns, and expectations of us. These PFC functions are collectively referred to as executive functions, and are clearly involved in prosocial behavior. If these functions are compromised in some way via damage to the PFC, the result is often antisocial behavior.

Positron emission tomography (PET) and functional magnetic resonance imaging (fMRI) studies consistently find links between PFC activity and impulsive criminal behavior. A PET study comparing impulsive murderers with murderers whose crimes were planned found that the former showed significantly lower PFC and higher limbic system activity (indicative of emotional arousal) than the latter and other control subjects (Raine et al., 1998). Cauffman, Steinberg, and Piquero (2005) combined reward dominance and PFC dysfunction theories in a large-scale study of incarcerated and non-incarcerated youths in California and found that seriously delinquent offenders have slower resting heart rates and performed poorly relative to non-delinquents on various cognitive functions mediated by the PFC.

**Some Other Biosocial Risk Factors**

There are numerous other biosocial risk factors, but we can only discuss a few here that we can relate back to issues in previous chapters to show how biological factors interact with the social context to produce behavior. For instance, in Chapter 6 we briefly discussed testosterone (T) in the context of male–female differences, but how about its effect among males only? Rowe (2002) discusses an interesting study of the effect of T among 4,462 males. The sample was divided into high T (upper 10%) and normal T (lower 90%) and into high and low socioeconomic status (SES). The study found that antisocial behavior more than doubled (from 14.7% to 30.1%) among low-SES/high-T males compared to low-SES/normal-T males. Among high-SES males, T levels had no effect on antisocial behavior. The interaction between T and social context is further illustrated in a longitudinal study of 1,400 boys, which found that T levels were unrelated to conduct problems for boys with “non-deviant” or “possibly deviant” friends, but conduct problems were greatly elevated among boys with high T who associated with “definitely deviant” peers (Maughan, 2005). Thus, the effects of testosterone depend quite a lot on social context, and this illustrates once again that we cannot separate biological and environmental variables and expect to understand complex behavior.

In Chapter 7, we discussed IQ without discussing biosocial factors that influence it. Exposure to noxious substances in the environment such as lead clearly reduces IQ. The IQ decrease per 1 unit increase in μg/dl (micrograms per deciliter of blood) of lead is an average of half a point (Koller, Brown, Spurfeon, & Levy, 2004). An fMRI study of predominantly black youths found that brain grey matter was inversely associated with average childhood lead concentrations in young adults (Cecil et al., 2008). The average childhood blood lead concentration of this sample was 13.3μg/dl, which is far in excess of the 2006 average of 1.5μg/dl for the general U.S. population (Bellinger, 2008). Although the grey matter lost to lead exposure was relatively small (about 1.2%), it was concentrated in vital behavior-moderating areas responsible for executive functioning and mood regulation such as the prefrontal cortex. Another study examined the relationship between childhood blood lead and verified criminal arrests. The average number of arrests for the males in the sample who were ever arrested was 5.2. The main finding of this study was that after controlling for other relevant variables, for every 5μg/dl increase in lead, there was an increase in the probability of arrest for a violent crime of about 50% (Wright, Dietrich, et al., 2008).
There are a number of neurological disorders that result from mothers drinking alcohol while pregnant, the most serious of which is fetal alcohol syndrome (FAS). FAS is a chronic condition resulting from an individual’s prenatal alcohol exposure. Prenatal exposure to alcohol disrupts the migration and hookup of the embryo/fetus’s developing neurons in brain areas such as the frontal lobes (Goodlett, Horn, & Zhou, 2005). The behavioral symptoms of FAS include low IQ; hyperactivity; impulsiveness; poor social, emotional, and moral development; and a predisposition to alcoholism (Walsh & Yun, 2011).

There are many other substances that have similar effects on neuron development and migration, because whatever the mother ingests, so does her embryo/fetus. A common risk factor is maternal smoking, which puts her fetus at risk for hypoxia (intermittent reduction of oxygen available to the fetus that may lead to brain cell death) (Zechel et al., 2005) as well as the toxic chemical components of tobacco (Huizink & Mulder, 2006). Cohort studies (e.g., Brennan, Grekin, & Sarnoff, 1999) consistently find that maternal smoking during pregnancy predicts criminal behavior in offspring independent of other factors. A review of a number of such studies found significantly increased risk for fetal tobacco-exposed individuals versus nonexposed individuals for various forms of antisocial behavior across diverse contexts and independent of other factors such as maternal SES and IQ (Wakschlag, Pickett, Cook, Benowitz, & Leventhal, 2002).

Table 8.1 summarizes the key concepts and strengths and weaknesses of biosocial perspectives and theories.

### Table 8.1: Summarizing Biosocial Perspectives and Theories

<table>
<thead>
<tr>
<th>Theory</th>
<th>Key Concepts</th>
<th>Strengths</th>
<th>Weaknesses</th>
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<tbody>
<tr>
<td>Behavior and Molecular Genetics</td>
<td>Genes affect behavior in interaction with environmental influences. Heritability estimates the relative contribution of genetic and environmental factors and traits affecting criminality. All individual traits are at least modestly influenced by genes.</td>
<td>Looks at both the genetic and environmental risk factors for criminal behavior. Understanding genetic contributions and also identifies the contributions of the environment. Provides “hard” evidence.</td>
<td>Requires twin samples and/or adoptees, which are difficult to come by. However, technology now enables us to go straight to the DNA in molecular genetics. Expensive and requires cooperation of lab scientists.</td>
</tr>
<tr>
<td>Evolutionary Psychology Perspective</td>
<td>Human behavior is rooted in evolutionary history. Natural selection has favored victimizing tendencies in humans, especially males. These tendencies arose to facilitate mating effort, but are useful in pursuing criminal behavior as well. Criminals emphasize mating effort over parenting effort more than males in general.</td>
<td>Ties criminology to evolutionary biology. Mating effort helps to explain why males are more criminal than females and why criminals tend to be more sexually promiscuous than persons in general. Emphasizes that crime is biologically “normal” (although regrettable) rather than pathological.</td>
<td>Gives some the impression that because crime is considered “normal,” it is justified or excused. Makes assumptions about human nature that may or may not be true. While recognizing that culture is important, it tends to ignore it.</td>
</tr>
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(Continued)
Evaluation of the Biosocial Perspective

Lilly et al. (2007) note that the most dramatic developments in science come most often from new observational techniques (think of the telescope and microscope) rather than new developments in theory. Criminologists now have access to new observational techniques in the form of DNA and neuroimaging data. “Never before has the sublime interplay between nature and nurture been available for scientific discovery” (DeLisi, 2009, p. 266), as it is today. The strength of biosocial approaches is that they take advantage of these new observational techniques and in their ability to incorporate biological concepts and findings that have been derived from these sophisticated physical measures into their theories. The main stumbling block is that such studies are more difficult to do and far more expensive than the typical social science study. If we want genetic information, we cannot simply go to the nearest high school and survey a few hundred students. Behavior genetic studies require comparing samples consisting of pairs of identical and fraternal twins and/or adoptees, and these are difficult to come by. However, new technologies have allowed us to go straight to the DNA, thus eliminating this need, but genotyping costs about $10 per individual.
It used to be difficult to make generalizations from the typical neuroimaging study because many tended to consist of a small number of known offenders matched with a control group. However, today there are some ambitious studies that are imaging anywhere from 400 to 2,000 subjects as costs continue to come down. Paus (2010) discusses four of these studies at length, including two longitudinal studies. All the studies are collecting mountains of environmental, behavioral, and cognitive data (e.g., socioeconomic status, maternal smoking, drinking, stressful life events, antisocial behavior, IQ, personality profiles, and many other things). Three of these four studies are also collecting DNA data. Thus, biosocial studies provide criminologists with “harder” evidence than they are typically able to get, and this evidence will help them to more solidly ground their theories. Biosocial analyses of many phenomena such as medical, psychiatric, and psychological problems are now all the rage in these disciplines, and many prominent sociologists and criminologists believe that this approach will prove just as useful in their disciplines. One of the most exciting advances is that some universities, such as the University of Texas at Dallas, are offering a double major in criminology and molecular genetics. In any event, as new discoveries are made in genetics and neuroscience, criminology can hardly ignore them.

**Policy and Prevention: Implications of Biosocial Theories**

The policies suggested by the biosocial perspective are midway between the macro-level sociological suggestions aimed at whole societies and the micro-level suggestions of psychological theories aimed at already convicted criminals. Mindful of how nurturing affects both gene expression and brain development in humans, many biosocial criminologists have advocated a wide array of “nurturant” strategies such as pre- and postnatal care for all women, monitoring infants and young children through the early developmental years, paid maternal leave, nutritional programs, and a whole host of other interventions (Vila, 1997). Some of the programs such as lead removal programs and educational programs to reduce maternal drinking and smoking should pay generous dividends in terms of reducing IQ loss and other negative factors caused by toxic lead and maternal substance abuse. Douglas Massey (2004), former president of the American Sociological Association, called for a biosocial understanding of such things:

> By understanding and modeling the interaction between social structure and allostasis [“allostasis” refers to the dysregulation of stress response systems such as the ANS discussed in the last chapter in response to chronic levels of stress], social scientists should be able to discredit explanations of racial differences in terms of pure heredity. In an era when scientific understanding is advancing rapidly through interdisciplinary efforts, social scientists in general—and sociologists in particular—must abandon the hostility to biological science and incorporate its knowledge and understanding into their work. (p. 22)

Biosocial criminologists are typically in the forefront in advocating treatment over punishment, and toward this end they have favored indeterminate sentences over fixed sentences (Lanier & Henry, 1998). Pharmacological treatments in conjunction with psychosocial treatments have proven to be superior to psychosocial treatment alone for syndromes (alcoholism, drug addiction, etc.) associated with criminal behavior (M. Robinson, 2009). Of course, there are always dangers in seeking simple medical solutions to complex social problems. Requiring sex offenders to take anti-androgen treatment to reduce the sex drive raises both medical and legal/ethical issues regardless of how effective the treatment is. Prescribing selective serotonin reuptake inhibitors such as Prozac and Zoloft helps to curb low
self-control and irritability, but there is always the temptation to treat everyone the same regardless of their serotonin levels.

One of the greatest successes of biosocial science was its pivotal role in the United States Supreme Court’s outlawing of the juvenile death penalty. In writing the majority opinion in *Roper v. Simmons* (2005), Justice Anthony Kennedy noted the neurobiological evidence for the physical immaturity of the adolescent brain, which was brought to the Court’s attention by the American Medical and Psychological Associations (Walsh & Hemmens, 2011). Thus, the biosocial approach can serve to advance arguments both for prevention rather than punishment and for punishments that takes into consideration valid physically identifiable differences among people.

Matt Robinson (2009), a sociologist who has spent much of his career researching crime prevention, states that

> since biosocial criminology meaningfully integrates perspective and theories from the biological and social sciences, the approach offers much hope in the area of crime prevention. At the very least, biosocial crime prevention should be far more effective than those strategies currently utilized. (p. 243)

Biosocial studies provide information about both environmental and biological risk factors and, as such, are “more likely to refine social policies by better specification of environmental factors than to divert funds from environmental crime prevention strategies” (Morley & Hall, 2003). In other words, they will enable us to better pinpoint environmental factors that may prove fruitful in our crime prevention efforts.

**SUMMARY**

- Behavior geneticists study the genetic underpinning of traits and characteristics in populations by calculating heritability coefficients. There are no genes “for” any kind of complex human behavior; genes simply bias trait values in one direction or another. This view is respectful of human dignity in that it implies self-determinism because our genes are our genes.
- Gene–environment interaction tells us that the impact an environmental situation (e.g., living in a crime-ridden neighborhood) has on us depends on who we are, and gene–environment correlation tells us that who we are is a product of our unique genotype and the environments we find ourselves in.
- Genes have practically no influence on juvenile delinquency, probably because of the high base rate of delinquency; i.e., almost all males commit some acts of delinquency, and thus there is little difference in behavior to be explained by either genes or environment. There are genetic effects for chronic and serious delinquents, but these few individuals tend to get “lost” in studies that combine them with those who limit their offending to adolescence. Adult criminality is much more influenced by genes. One of the reasons that we find only modest genetic effects in criminality when the traits that underlie it are strongly influenced by genes is that parents may have control over their children’s behavior but little or none over their underlying traits.
- Evolutionary psychology focuses on why we have the traits we do, and is more interested in their universality than in their variability. Crime is viewed as a normal but regrettable response to environmental conditions. By this it is meant that many human adaptations forged by natural selection in response to survival and reproductive pressures are easily co-opted to serve morally wrong purposes.
In common with all sexually producing species, humans are preeminently concerned with our own survival and reproductive success. The traits designed to assist males in their mating efforts include many that can also assist them to secure other resources illegitimately; in contrast, traits designed to assist females in their parenting efforts are conducive to prosocial behavior. Mating vs. parenting effort is not an either/or thing; males and females engage in both at various times in their lives. It is just that mating effort is more typical of males, and parenting effort is more typical of females.

Socially cooperating species create niches that cheats can exploit to their advantage by signaling cooperation but then defaulting. Cheating is a rational strategy in the short term, but invites retaliation in the long term. This is why chronic criminals rarely have successful relationships with others and why they typically die financially destitute.

Neuroscience tells us that genes have surrendered control of human behavior to the brain. Following genetic wiring to jump-start the process, the brain literally wires itself in response to environmental input. The “softwiring” of our brains is an electrochemical process that depends on the frequency and intensity of early experiences. Adverse experiences can literally physically organize the brain so that we experience the world negatively, which is why nurturing, love, and attachment are so important to the healthy development of humans.

Reward dominance theory informs us that the brain regulates our behavior through the BIS and BAS systems (underlain by serotonin and dopamine neurotransmitters, respectively). In most people the BAS and BIS are balanced, but criminals tend to have either an overactive BAS or an underactive BIS. This means that their behavior is dominated by reward cues and relatively unaffected by punishment cues.

Prefrontal dysfunction theory posits that the brain’s prefrontal cortex (PFC) is vital to the so-called executive functions such as planning and modulating emotions. If the PFC is damaged in any way, the individual is deficient in these executive functions and tends to be impulsive.

DISCUSSION QUESTIONS

1. If it could be shown with high scientific confidence that some young children inherit genes that put them at 85% risk for developing antisocial propclivities, what do you think should be done? Should their parents be warned to be especially vigilant and to seek early treatment for their children, or would such a warning tend to stigmatize children? What are the costs and benefits of each option?

2. We know that males, especially young males, are more likely to perpetrate and be victimized by violent crimes. Provide a plausible evolutionary explanation for this.

3. How might reward dominance theory add strength and coherence to low self-control theory?

4. Explain why the traits underlying mating versus parenting effort are related to crime.

USEFUL WEBSITES


Evolution’s Voyage (Evolutionary Psychology). www.evoyage.com/
The Human Brain. www.fi.edu/brain/index.htm

## CHAPTER TERMS

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<th>Gene–environment correlation</th>
<th>Parenting effort</th>
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<td>Fight or flight system</td>
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