The most amazing and complex thing known in our world is the human brain. Although the average adult brain weighs approximately 3lbs., this relatively small mass of squishy tissue is the source of every thought, emotion, decision, and action that is made by an individual. Traditionally, it was believed that by the time the brain had reached adult size (around age 10), it stopped growing and producing new cells. However, research in the past decade has demonstrated that the brain is constantly developing and making new cells (called “neurogenesis”) even into old age (Gage, 2002; Gould, 1999; Ritter, 2002).

For many years, researchers believed that the only vital period of growth in the brain was in the first few years of life. It is true that the most significant and vital period of development occurs in the perinatal and early years. To illustrate, approximately 95% of a child’s brain has structurally developed to adult size by age 6. In addition, most of the neurons we have were developed when we were still in the womb; actually, adults typically have fewer than they had before they were born because of the extraction of those that are unused in development. Although it is
true that the brain develops in structural volume very little after age 5, key stages of growth in both structure and function occur throughout life, especially through age 25. Furthermore, neural paths are formed throughout the life span of normal individuals.

Given that the brain plays such a vital role in all cognitive functions, it follows that criminal activity is a result of the various processes going on in our heads. Whether the reason to commit an offense is to make money, to get revenge, to get a “rush,” or just sheer stupidity, the brain always plays a central role. Therefore, any reasonable attempt to explain criminal behavior must incorporate an understanding of the brain, particularly the likely problems that can occur in its structural development and intricate processes.

Unfortunately, the amazing complexity of human cognition makes it particularly vulnerable to a myriad of developmental maladies that can result in mental deficits, which may predispose individuals to criminality. This chapter, as well as the following chapter, will present a basic overview of brain structure formation with a special emphasis on the differential functions of the various structures and lobes, with the current chapter focusing on the hindbrain, midbrain, and subcortical regions, and the following chapter focusing on the forebrain. Although this review is far from comprehensive, our goal is to discuss the relevant concepts and issues that most likely affect our cognitive configuration and functioning in terms of developing criminality. The reader should note that other considerations that we do not discuss may be important in the way the brain affects our behavior; however, because of space limitations, we have narrowed our discussion to the concepts and issues that have received the most attention and empirical support, or seem to be particularly worthy of more attention in the etiology of criminal offending.

**Brain Development and Structure**

The brain, which is composed of many regions and structures, is the most important bodily organ in the commission and inhibition of criminal behavior. This much we know. However, outside of this general statement, links between specific brain structures and particular types of behavior have not been well established. This is largely due to the fact that our understanding of the brain and its development is still rather primitive. The good news is that scientific knowledge on cognition is growing at an exponential rate. Because of this immense growth in information, a comprehensive description of brain development would take many volumes. Therefore, our review in this chapter (and the following chapter) will focus on basic essentials that are most relevant in understanding neurological influences in individuals’ development toward criminality.

It should be noted that developmental differences may be related to brain structure and/or brain function, which may occur independently or simultaneously. In other words, a tomographical image of the brain structure of an individual may appear quite normal, whereas the actual functioning (internally, externally, or both) may be abnormal in that there may be structural maladies that do not allow healthy functioning of the brain. Given this distinction, we will first examine brain configuration and issues related to formative development. After identifying
individual brain structures and their location, we will provide descriptions of the primary jobs that each of the structures is responsible for carrying out. Most importantly, we will discuss some of the observed links between these specific brain structures and criminality. Thus, the focus in this chapter is on hindbrain and subcortical structure and region-specific regulations, whereas the forebrain structure is the focus of the following chapter, and the specific mechanics of brain and nervous system functioning is the emphasis of the following chapters.

The reader should keep in mind that some of the current conclusions regarding links with criminal behavior are still somewhat preliminary and not yet well-established. Future research will ultimately determine which of these associations is valid in explaining our decisions to commit (or not commit) crime. Nevertheless, we provide the current state of understanding regarding brain development and criminality.

**Hindbrain Structure and Functioning**

The initial sequence of brain configuration is largely programmed by one's genetic makeup when in the womb. Soon after conception, the brain begins as a primordial tube-like structure that develops rather quickly into three distinct parts: hindbrain, midbrain, and forebrain. Also referred to as the brain stem region, the hindbrain forms as a continuation of the spinal cord and includes such structures as the medulla oblongata, cerebellum, raphe nucleus, and pons (see Figures 5.1 and 5.2).
This lower portion of the brain is the most primitive region; in fact, we inherited the brain stem from our reptilian ancestors. Although it has been altered in humans through evolution, the basic structure of the hindbrain is often referred to as the r-complex (as in reptilian) because of its developmental origins. This region is responsible for maintaining life without conscious thought. This may be why many lower species generally function the same when their forebrain is removed. They continue to breathe, eat, sleep, and mate much like before such removal took place. Because they never engaged in much problem solving or abstract thinking, their existence is largely unchanged despite this significant difference in brain structure. Still, it is important to understand the primary structures in the human hindbrain because if they are not functioning properly, that can seriously affect cognitive ability and resulting behavior.

The medulla oblongata contains tracts and reflex centers (part of reticular formation [see below]) that are largely responsible for basic bodily functions such as respiration (e.g., breathing); cardiovascular function (e.g., heart rate, blood pressure); and other essential processes (e.g., vomiting). The medulla is the lowest lying structure of the brain and can best be thought of, in terms of structure and functioning, as an enlarged extension of the spinal cord.

Key for our purposes, the medulla oblongata is an important “station” for the reticular formation—also called reticular activating system (RAS)—which is an organized network of nerve cell bodies that extends to other regions of the brain, including those in the midbrain and forebrain areas. The RAS is vitally important in controlling complex reflexes (e.g., sneezing) and motor activities, and most importantly, in aiding higher brain centers in determining levels of arousal. The importance of this last function of reticular formation will be discussed later, but the reader should note here that structural damage or abnormal functioning of the RAS in the medulla oblongata is a predicting factor in the development of disposition toward criminality.

The cerebellum, like the medulla, contains reflex centers for maintaining posture and advanced motor activities (e.g., muscle contractions, limb movements). Two important functions of the cerebellum are of particular interest to criminologists. The first involves aiding the higher brain centers in establishing effective spatial orientation, which we will see has important implications on the cognitive processes of an individual. The other key function of the cerebellum for our purposes is that it acts as a type of mediator or command center for a variety of sensory signals. More specifically, it integrates numerous forms of information from the eyes, ears, skin, and so on, and combines this knowledge with that of its spatial function and messages from the higher brain areas in order to produce the most effective motor response in a given situation. Studies have shown that the cerebellum coordinates learning and helps coordinate fine-tuning of social tasks, and that structural changes in this brain region peak at age 18.

Sometimes, our complex motor skills are primarily learned in other areas of the brain but then stored in the cerebellum. This makes it much easier for us to engage in complex physical tasks without having to learn them over and over again. Rather, we can devote more of our brain “energy” to other purposes once we have initially learned the motor skill. For instance, when initially learning to walk, ride a bike, or drive a car with a stick shift, we would be using the motor cortex region of the brain (which is located near the top of the cerebral cortex where the frontal and parietal lobes meet; see Chapter 6). However, retaining the ability to walk, ride a bike, or drive a manual transmission from that point would largely be a function of the cerebellum.
Animals that engage in complex motor activities that require the highest levels of equilibrium, balance, and spatial positioning—for example, birds that fly—have the largest cerebellums relative to size (Starr & Taggart, 1987). The malfunctioning of the cerebellum is perhaps best illustrated in humans when a large quantity of alcohol has been consumed. The effects of alcohol on the cerebellum are what cause the “drunken sailor” walk, often to the point of falling down. Other complications resulting from a poorly functioning cerebellum are dizziness/nausea (i.e., vertigo), slurred speech, loss of motor coordination, and tremors. The implications of structural differences in the cerebellum will become clear later when we discuss such links with criminality, particularly the differences between men and women in terms of brain functioning.

Figure 5.2 The Human Brain Stem. Here, the major structures of the brain stem may be seen.
As shown in Figure 5.2, the reticular nuclei is a portion of the brain stem that is home to neurotransmitter cell bodies (e.g., serotonin; see Chapter 7) that create and disperse such neurotransmitters to other parts of the brain. (This system consists of the nucleus cuneatus and nucleus gracile, as shown in Figure 5.2.) This section of the brain stem has been implicated in several clinical disorders. For example, this region has been found to be lacking in serotonin by as much as 40% in individuals who have been diagnosed with bipolar disorder, which may contribute to atrophy of neuronal and synaptic development.

Another structure of hindbrain is the pons (see Figure 5.1), which is largely a region through which nerve tracts pass on their way from one brain center to another. In fact, the word pons means “bridge.” This is an appropriate name for this structure because of its primary function of connecting the rest of the hindbrain, particularly the cerebellum, to the higher brain centers such as the limbic system. One of the known features of the pons is that it acts as a key structure in our ability to experience dreams, which occur during rapid eye movement (REM) episodes of the sleeping state (Kantrowitz, 2002; Solms, 2004). Research has established that such phases of sleep are necessary for internalizing and interpreting memories in our brain. Recent studies have also found that inhibited or interrupted REM states can have a profound effect on behavior. For example, individuals who fail to experience a healthy level of REM sleep have been shown to be more irritable and aggressive, and they lack the ability to remember as compared to those who do not experience such sleeping states.

Although the pons has not been linked directly with criminality, its malfunction is likely to be an intervening element in brain processes that are commonly found in chronic offenders. For instance, if the stimuli normally processed in the medulla and cerebellum are not properly transferred to the mid- or forebrain regions, then sound cognitive decision making will be inhibited. Another possible scenario involves the lack of REM sleep in producing a disposition toward irritability and aggressiveness that has been observed in individuals who have an impaired pons. These types of scenarios, as well as other possible deficiencies, suggest that the pons and other areas of the hind region should be examined more by future criminological research.

Midbrain Structure and Functioning

The midbrain is an important area due to the convergence of sensory information in this region. Although the midbrain is much more important in controlling bodily responses in fish and amphibians (e.g., frogs can function normally without their forebrain as long as their midbrain is intact), it is still an important region in humans despite its relatively small size. The roof of the midbrain, called the tectum (meaning “roof” in Latin), integrates incoming visual, tactile, and auditory signals in order to coordinate reflex responses. The tectum contains nerve tracts that attach directly to the thalamus and ultimately link up to the cerebrum and other forebrain regions.

Also important in the midbrain is the reticular activating system (RAS), also called the reticular formation, which includes the tegmentum (meaning “cover” in Latin) and various nuclei (as shown in Figure 5.2) and colliculi (meaning “little hills”
in Latin), as shown in Figures 5.1 and 5.2, which provide necessary communication paths between the hindbrain and forebrain areas. Although the RAS begins in the core of the medulla oblongata and stretches through the midbrain to the lower regions of the forebrain, the central core of the RAS is located in the midbrain. In ways that are not yet fully understood, the reticular formation works to sort out important stimuli from all input so that it may be forwarded to the higher brain centers that manage conscious thought processes. Studies suggest that this filtering function of the RAS is likely developed from both innate genetic wiring and learning, and its effectiveness can be seen in a mother who sleeps through loud noises but wakens upon hearing the faint cry of her infant (Audesirk & Audesirk, 1989).

Furthermore, the RAS serves as a type of toggle switch that controls which higher brain system—limbic system or cerebrum (higher brain)—is in charge given the current situation (both of these systems will be discussed below). This toggling of the RAS tends to occur when we are either emotionally charged or relaxed (Howard, 2006). When we are in a highly emotional situation, such as being in danger, the RAS tells our brain to shut down the higher brain (cerebrum) functioning while emphasizing the limbic system (emotional center). This fight-or-flight mode forces our brain to rely on instinct or previous experience in handling the situation. Such situations occur when we are being challenged by others or during scary events, such as encountering a bear when we are hiking in the woods. On the other hand, the RAS will tell our brain to relax the limbic system when we are relaxing in our home, which allows our higher-learning brain to take control of our functions. This is why constructive learning can take place only if an individual is in an environment that poses no danger or risk to the individual. Implications from this can be seen in the learning differentials between students in stable, safe schools as compared to those in schools that are riddled with gangs and crime. If students are always on guard against potential dangers, they will not learn as efficiently as those in safe environments.

Colliculi, which are responsible for reflexive responses to auditory and visual stimuli, are divided into two structures: inferior colliculus and superior colliculus (see Figure 5.2). The inferior colliculus is responsible for responding quickly to auditory stimuli. For example, if a sudden blast occurs, we will automatically jerk to look at it. However, this reflex can be controlled, particularly if we are expecting such a noise, such as when someone is hunting and he or she hears a crack of a twig. The superior colliculus is responsible for reaction to visual stimuli. When you see a movement in your peripheral vision, you will automatically look at it. Such quick and automatic response is generally important for survival given the need to see projectiles coming at one’s body. This reflex is harder to control than auditory signals governed by the inferior colliculus, even when one is anticipating such visual stimuli. For example, planes that drop nuclear bombs tend to use heavy curtains to protect their crew from inevitably looking when the bomb goes off. All persons will look toward strong rays of light, even those that may damage their eyes. This reflex is a result of millions of years of evolution and, thus, is almost impossible to override even when one makes every conscious effort to do so.

After reviewing the brain stem region and midbrain, it is not surprising, given the limitations of their cognitive structure, that fish, amphibians, and reptiles are capable of little else than sleeping, eating, fighting, and reproducing. Although the
reticular formation strongly links the hindbrain to other regions and allows for some level of arousal in this basic makeup, no advanced cognitive thought processes are possible without the more advanced regions (e.g., forebrain). Fortunately, our brain structures evolved considerably beyond this stage.

This is not to say that this region is not extremely important in terms of emotions and behavior that directly affect criminality. For example, recent brain imaging research has shown that modern drugs (e.g., selective serotonin reuptake inhibitors [SSRIs]) that are effective in curbing depression and other disorders work by affecting the functioning of the primitive hind regions of the brain (see Mayberg et al., 2005). Despite the primitive nature and limitations of the r-complex, the brain structures (e.g., ventral tegmental) and functioning in this region—particularly that of the RAS—have important implications for criminality that will be addressed later in this chapter. Nevertheless, the significance of the hindbrain and midbrain regions is often overshadowed by the more distinguishable region in humans: the subcortical region of the forebrain area.

**Structures of the Subcortical (Limbic) Region**

Covering the hindbrain and midbrain regions, the next area to develop is the limbic system (or leopard complex) that evolved during the emergence of new lifestyle characteristics, particularly those of early mammalian life forms (e.g., leopards) who spent more time involved in play, pair-bonding between sexual partners, and nurturing their young (Ellis & Walsh, 2000). Along with the brain stem, the limbic system (see Figure 5.3) helps regulate blood pressure, heart rate, blood sugar, and other important bodily functions. Importantly, this region of the brain, which is also called the paleomammalian system (paleo meaning “early”) because of the evolutionary stage in which it emerged, largely coordinates nerve impulses to and from the skeletal muscle and internal organ activity involved in emotional expression (particularly the “social emotions” that will be discussed at length later).

Through a complex series of processes, these emotional impulses trigger limbic structures (e.g., hypothalamus) to release a variety of hormones that physiologically alter our bodies both structurally and functionally via chemical and electrical stimuli. Importantly, the limbic system also communicates with the frontal cortex and other higher regions, where the emotional signals and reason are integrated into purposeful planning and decision making. Thus, it is easy to understand how a breakdown in the functioning of the limbic system could have serious implications in terms of criminal behavior.

Accounting for approximately one fifth of brain volume, the limbic system consists of a diverse group of brain structures that play key roles in responsiveness and learning, which are essential in understanding the development of criminality. Although considered a portion of the forebrain, the limbic system lies below the relatively large cerebral cortex (also called the cerebrum) and is therefore considered part of the subcortical region.

The limbic system is responsible for a variety of functions, including regulating motivation, libido, bonding with others, appetite, sleep, and other activities.
importantly, this system sets the emotional state of the brain and remembers such emotional states. If a person has problems in the limbic system, he or she is more likely to be irritable, pessimistic, unmotivated, and isolated, as well as criminal. Although most brain studies (for a review, see Raine, 1993; Rowe, 2002) have implicated the frontal and temporal regions of the cerebrum as being the most vital areas for criminological research, we disagree. We believe most of the problems with individuals are due to problems in the limbic system structures and their interconnections, or lack thereof. The diverse group of structures that makes up the limbic system will now be reviewed.

**Amygdala and Hippocampus**

Found in the lower part of the limbic region (see Figure 5.3), the *amygdala* is an almond-shaped emotion and partial memory center, and the *hippocampus* is the primary memory center. These two brain formations are believed to be the most relevant portions of the brain underlying emotions and feeling states related to survival functions (e.g., fighting), as well as to social functions and responses (e.g., jealousy, anger). For instance, the amygdala has been found to be directly responsible for changes in violent or hostile activity, particularly when it is injured or altered (Blundell, 1975). Ironically, much has been discovered about the amygdala inhibiting aggression in animals, which is likely in humans as well (Mirsky & Siegel, 1994). The amygdala has been implicated in numerous clinical problems. Specifically, in bipolar disorder the amygdala appears to show a significant increase
in neural transmissions toward emotional stimuli, and in many situations shows a reaction that goes beyond a typical response.

The amygdala has also received a lot of attention because it is the most seizure-prone structure in the brain. Modern medical procedures that have been developed to limit excessive epileptic seizures have, in turn, also led to procedures to manipulate the amygdala in order to reduce aggression in people, typically psychiatric patients. In fact, amygdalectomies—the severing of neural connections between amygdala and surrounding regions—have been used for some time in countries such as Japan and India to diminish aggressive and destructive behavior in both children and adults. Such attempts have shown mixed success, but the ethical problems in using such measures among convicts would generally preclude its use. Nevertheless, a relatively recent review of these studies (Raine, 1993) concluded that “amygdalectomy may be more effective than earlier studies indicate” (p. 124).

The amygdala is extremely important in integrating senses (such as combining what is heard with what is seen) and in forming memories by linking particular emotions with given inputs from the environment. This last function is especially important in the maintenance of social emotions (e.g., shame, pride) and moral reasoning that seem to play a significant role in dispositions toward criminality (Chandler & Moran, 1990; Tangney, 1995; see Chapter 8). It is notable that the brain structures that regulate the amygdala, such as the frontal lobe, are not completely developed in teenagers, which may explain why they seem to engage in impulsive behaviors without any constraint or consideration for long-term consequences of their actions.

**BOX 5.1 Psychopathy, Amygdala Dysfunction, and Inability to Recognize Emotion**

A revealing study that was published in the *Journal of Genetic Psychology* (Stevens, Charman, & Blair, 2001) examined the ability of children with behavioral and emotional difficulties, who had been divided according to their scores on a psychopathy screening device (see Frick & Hare, 2001), to recognize emotional facial expressions and vocal tones. The children with psychopathic tendencies and a group of comparison children were presented with two facial expression and two vocal tone subtests from the Diagnostic Analysis of Nonverbal Accuracy (Nowicki & Duke, 1994). These subtests measure the ability to accurately identify happy, sad, fearful, and angry facial expressions and vocal effects. The children with psychopathic tendencies showed impairments in the recognition of both fearful and sad facial expressions as well as a sad vocal tone. The results were interpreted by the authors as suggesting that the development of psychopathic tendencies may reflect early amygdala dysfunction.

Given the important role of the amygdala in the area of recognizing and responding to various emotions, it is not surprising that this study and others have consistently reported finding deficiencies in this brain structure among psychopaths. After all, one of the key characteristics of psychopaths is the inability to feel strong emotional bonds with others or to empathize with their victims. It is likely that this lack of emotion is also tied to their amazing ability to lie to others and treat others poorly without feeling pangs of conscience or guilt. So trauma or other negative influences in the early development of the amygdala (as well as other structures in the limbic system) can have profound effects on the development of psychopathic and antisocial tendencies.
Named for its resemblance to a seahorse, the hippocampus is another very important structure in the lower limbic region. Along with the frontal cortex and thalamus, it is one of the most important structures in the formation of long-term memory and is vital in the integration of certain types of information, such as associations between one thing and another. Failure to understand links between different occurrences (or the ability to remember those links) reduces the ability of individuals to anticipate and/or comprehend cause-effect relationships; criminals, particularly violent offenders, have been found to lack this ability (Larson, Lynch, Games, & Seubert, 1999). To clarify, if an individual cannot predict how his hitting a co-worker will likely result in loss of employment, then this obviously would predispose such an individual toward using violence in times of anger. Continuously communicating with the frontal cortex, a healthy functioning hippocampus is key in forming cognitive maps of such causal processes.

Besides being a key memory center, one of the responsibilities of the hippocampus is to maintain equilibrium among the flow of signals between neurons, which are communicating important signals to different regions of the brain. This function becomes particularly important during times of stress or arousal, which we will see is of particular interest in understanding criminality. Because the hippocampus is a primary memory structure and regulatory unit of the brain, it is easy to imagine that a damaged or malfunctioning hippocampus would produce various implications for predisposing one to developmental problems throughout life, such as learning disabilities, poor school/work performance, and so on.

Recent studies have shown that new cells are often produced in the hippocampus, as well as other areas of the brain (e.g., the olfactory bulb). However, when individuals experience a prolonged period of stress, it triggers a state of depression, which suppresses neurogenesis (i.e., origin of cells) in the hippocampus. This results in a shrinking of the hippocampus. Recently developed drugs attempt to compensate for this reduced rate of cell production, but their delayed rate of effect is understandable in the sense that it takes time to tell the hippocampus to produce new cells that lift the mood of individuals. Notably, physical exercise naturally increases the production of neurogenesis in the hippocampus, as does electroconvulsive therapy, otherwise known as “shock therapy,” which is currently practiced by many respected institutions.

The results reported above are consistent with a recent study that further explored the effects of hippocampus size (Gilbertson et al., 2002). This study examined 40 twin pairs (80 identical twins), 40 who saw combat in Vietnam and their identical counterparts who did not see combat, and found that the size of the hippocampus predicted the vulnerability of certain individuals to posttraumatic stress disorder (PTSD). None of the “stay-at-home” twins had experienced PTSD, and of the combat veteran twin counterparts who were diagnosed with PTSD, there was a statistically significant likelihood that they had a smaller hippocampus than their counterparts. In the veterans who were affected, hippocampal volume was 10% smaller on average than that of others who had seen combat. This study actually showed that individuals with smaller hippocampal structures are more likely to suffer from PTSD and other anxiety or mood disorders.

Additionally, other studies using brain imaging have found that individuals with smaller hippocampus structures are more susceptible to clinical depression (Sheline,
Mittler, & Mintun, 2002). This problem has become a priority in mental health because of recent findings that show an actual shrinkage of the hippocampus in persons suffering from forms of dementia and Alzheimer’s disease. However, preliminary studies also indicate that new medications may not only delay this reduction, but may actually reverse it in many cases (Underwood, 2002). Some experts currently believe that directly stimulating the hippocampal region may actually be a more efficient way of dealing with depression, as opposed to more indirect ways of manipulating neurotransmitters (e.g., serotonin) via current mainstream drugs (SSRIs).

One related area of research involves what causes the hippocampus to shrink. The best guess currently is the stress hormone cortisol and its chemical cousins or derivatives. *Cortisol* is key in priming the mind and body for stressful events, but studies have established that in frequently high levels, cortisol negatively affects the hippocampal structure and function, as well as other related areas of the brain. So one promising area of research involves medication and/or behavioral therapy that attempts to keep cortisol levels in check. We will see in following chapters that cortisol and other related hormones have implications for gender differences in cognition and even criminality, which are likely related to its influence on the hippocampus and related brain structures.

Not surprisingly, studies have shown that injury to or failure of the amygdala/hippocampal area has been linked to criminality, particularly when the injury was to the left hemispheric portions of these centers (for a summary, see Volavka, 1999). It is important to note that the amygdala and hippocampus are two of the most “plastic” structures of the brain, meaning that they change physiologically as a result of cues from environmental experiences. This, too, will become important later when we further discuss the behavioral inhibition system of individuals that suppresses irrational behaviors (similar to Freud’s superego). For now, it is sufficient to realize that the amygdala/hippocampal area is continually being calibrated according to cumulative experiences and that the earlier these experiences occur, the more effect they seem to have for better or for worse (Walsh, 2002).

**Thalamus, Hypothalamus, and Pituitary**

Other important structures of the limbic region include the thalamus, the hypothalamus, and the pituitary gland, which all play key roles in the functioning of the nervous systems—both central and peripheral—for which the brain acts as command central (see Figure 5.4). The thalamus is a major coordinating center for sensory and motor signals. It serves as a relay station for sensory impulses (e.g., pain) from all over the body, sending them on to the higher regions in the cerebral cortex. The thalamus receives and passes on sensory impulses for all of our senses except for smell (which is unique in that it goes directly from the olfactory area in the lower frontal lobe to the hypothalamus). Because of this role in the relaying of most of our sensory information, the thalamus is very important in the formation of memory, which is basically the process of storing things that we see, hear, touch, and taste, so that we can use that information in a useful way, such as positive reinforcement or punishment for behavior. One example of the importance of the thalamus in feeling sensations of pleasure and pain is its strong relation to *septal*
nucleus (i.e., septum), which sits adjacent to and just in front of the thalamus and is the center for sexual orgasm. Obviously, if the thalamus is not operating efficiently, our ability to sense and learn from our environment, as well as the capability to remember such experiences, will be seriously impaired.

The thalamus not only passes on this sensory information to the higher regions of the brain, but also plays an important part in sorting what is important from what is unimportant. One of the key areas to which the thalamus projects these signals is known as the “prefrontal” area of the cortex, which is the most anterior part of the frontal lobe. This prefrontal area is generally considered the brain region that is most centrally involved in abstract cognitive functions and higher intelligence, as well as behavioral inhibition and emotion regulation. Furthermore, the thalamus works in conjunction with another subcortical structure, the hippocampus, to assist the cerebrum in regulating individuals’ level of cortical activity.

This level of activity can be measured, albeit not specifically, by an electroencephalograph (EEG, which will be discussed in more detail in a later section). Unfortunately, the EEG cannot distinguish the particular roles of the thalamus or hippocampus in the regulation of such activity. Nevertheless, the role of the thalamus in processing brain signals, especially those related to criminal behavior, is very important. Unfortunately, research has not explored the direct links between thalamus dysfunction and criminal activity.

Just below the thalamus sits the hypothalamus, which largely monitors body temperature and blood pressure, as well as hunger and other visceral activities. Along with

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**Figure 5.4** A View of the Human Brain Showing the Hindbrain and Forebrain Structures
the thalamus and hippocampus, the hypothalamus works with the frontal cortex in the formation of long-term memory. The hippocampus has close communication lines established with the hypothalamus, largely by way of a bundle of axons called the fornix (see Figure 5.4). It is likely that when there is a communication problem in the hippocampus-fornix-hypothalamus system, there are perceptual and consequential behavioral problems (Fishbein, 2001). Perhaps most importantly, the hypothalamus, along with the pituitary gland (see Figure 5.4), coordinates the neuroendocrine system. Together, the hypothalamus and pituitary form a partnership, often referred to as the H-P system, that determines the levels of various chemicals throughout the brain and body that largely regulate the way we perceive and behave in our environment.

The neuroendocrine system consists of the complex network of structures and processes whereby a variety of hormones are released internally into the bloodstream in order to influence the activities of tissues and organs. The hormones are released by various glandular structures (e.g., the thyroid and adrenal glands), with the “master gland” being the pituitary, which is suspended by a slender stalk that extends downward from the hypothalamus. It is interesting that the pituitary is relatively small in all humans (about the size of a green pea), given the pervasive role it plays in a variety of functions.

The pituitary has a posterior lobe and an anterior lobe. The posterior lobe is largely responsible for producing hormones that regulate kidney function through the production of antidiuretic hormone, which is not known to have links to criminality. On the other hand, the anterior pituitary produces a variety of hormones, including growth hormone, prolactin, and adrenocorticotropic stimulating hormone (ACTH). Problems, including those of perception and behavior, tend to occur when there is an excess or deficiency of one of these hormones, especially ACTH (which will be discussed later in this book). It is obvious that there are many criminological implications regarding the pituitary in regulating various hormones that influence decision making and rational thought processes. We will be reviewing some of these effects below, as well as in the following chapter.

One of the most important roles the pituitary gland plays is in the realm of sleep. During sleep states, the pituitary releases growth hormone, which stimulates the production of various proteins that aid in helping to repair damaged tissues in the body. Also, this pituitary gland releases important sex hormones during puberty that help explain the intensity of teenagers’ emotions and may be responsible for their erratic behavior. In conjunction with the hypothalamus, the pituitary works to regulate hormones that control human emotions, including aggression, that have vital implications for criminality. More discussion regarding such hormones will occur in future chapters.

The hypothalamus is, in a sense, a “brain of the brain” in that it sends electric and chemical signals that command the secretion of various hormones—such as stress and sex hormones—that set into motion an immense number of actions in various parts of the body. One well-known example is menstruation, which begins (obviously in females only) in the brain as a hormonal feedback loop between the hypothalamus and the pituitary gland (Halpern, 2000). The neuroendocrine system will be discussed in more detail in later chapters, as will the specific hormones that have been linked to criminality.
A part of the hypothalamus called the supra chiasmatic nucleus (SCN) interprets signals from the eyes to control falling asleep and awakening. The SCN is named for its location above (hence supra) the optic chiasm, which is shown in Figure 5.4. The SCN is composed of the cells in the front of the hypothalamus that are active in sleep but not in the waking period, and these frontal cells communicate to the back portions of the structure to tell what is going on; however, in some individuals, this communication is not efficient or is disturbed by abnormal biochemical signals. This results in sleeping and waking disorders that may have profound effects on individuals' behavior. Also, signals from the retina in our eye determine information that is relayed through the optic nerve, the optic chiasm, the SCN, and the rest of the hypothalamus. When the sun goes down each day, the SCN also communicates with the pineal gland (shown in Figure 5.4) to trigger the production of melatonin, a hormone that induces sleepiness. Interestingly, melatonin levels can be reduced at night if an individual stays in bright light; on the other hand, melatonin production can be triggered during the day if an individual is in darkness.

The hypothalamus has been found to have important effects on various correlates of criminality. For instance, the hypothalamus largely controls heart rate and other functions of the autonomic nervous system, which has been strongly linked to criminality (see future chapters). The hypothalamus is a vital component in the management of affect and emotion, which, of course, is essential in understanding situational behaviors (Fishbein, 2001). Studies have also shown that lesions in the hypothalamus caused by severe head blows from child abuse has been linked to the development of criminality, particularly violent offending, in later years (McCanne & Milner, 1991; for a discussion, see Raine, 1993).

Furthermore, the relative size and structure of the hypothalamus has been shown to vary between human males and females, as well as across rodent species, due to evolutionary adaptations (see Walsh, 2002). Regardless of size differences, the hypothalamus-pituitary connection is important in the production of reproductive hormones (e.g., androgens). Studies have clearly shown that when male hormones are produced, typical male behavior results, and when such androgens are removed, typical female behavior results (for a review, see Halpern, 2000). This link has important implications given the consistently strong finding that males tend to be much more aggressive and criminal than females (see following chapters). Thus, whether as dual control centers for the neuroendocrine system or as separate brain structures, the hypothalamus and the pituitary gland are certainly two of the most important structures in the development of criminality (see further discussion of the hypothalamic-pituitary-adrenal [HPA] axis). Studies have also linked the hypothalamus with headaches due to its part in regulating hormones, sleep, and hunger. For example, migraine headache symptoms are linked with nausea and vomiting, which are signals sent from the hypothalamus to the migraine generator of the brain, the upper brain stem. Research regarding headaches is largely unexplored but is quite worthy of further investigation by criminological researchers.

Another important factor related to the HPA system is the level of anxiety persons experience. The abnormalities that cause some people to have health and psychological problems are often due to a system that causes “overdrive” production of the fight-or-flight response, which results in such physiological responses as higher
breathing and heart rates, as well as increases in blood pressure. Specifically, abnormalities in the hypothalamus can cause an excess in chemicals that stimulate the pituitary gland. This often results in overproduction of ACTH in the pituitary (see above), which tells the adrenal glands to kick in. In turn, the adrenal glands release the hormone cortisol, which acts to boost blood sugar to give the body more energy to deal with stress. There are important functions and reasons for the production of ACTH and cortisol, which are vital for normal functioning and adapting to stressful conditions. However, some individuals have physiological dispositions or environmental conditions that tell their nervous system to produce an excessive amount of these chemicals.

Problems with this system, such as excessive levels of stress because of abuse, can lead to difficulties in handling normal activities. Studies have shown that abnormal levels of cortisol are significantly linked to criminal activity (for a review, see Raine, 1993). Chronic levels of cortisol production, as well as other chemicals involved in this process, can actually lead to death because of the constant draw on the body from unrelieved stress. A healthy HPA system is required for healthy and normal functioning, but that system can be detrimental when one of its components, be it the hypothalamus, pituitary, or adrenal glands, is not functioning properly and gears our system into a constant state of arousal. This type of system is often seen in persons who were chronically abused or neglected in early years of development (Perry, 2001).

Other important brain structures located in or near the limbic region should be discussed. Although virtually no studies have identified these areas as important in the study of criminality, we believe their possible role should be considered more carefully. The first of these structures, the pineal gland, can be found on the back side of the limbic region, situated just behind the thalamus (almost like a stub tail; see previous figures). This cone-shaped structure has been considered a vestigial third eye in light of its important role in receiving nerve impulses from the eyes and its prominence in certain species that depend on extraordinary sight, such as birds. The pineal gland, like most other structures in the neuroendocrine system, largely functions according to signals it receives from the hypothalamus. As regulated by the SCN (see above), the pineal gland releases melatonin, which is a hormone that brings on sleep and drowsiness.

Although more important in lower species, the pineal gland still plays a role in reproductive physiology and, more uniquely, is responsible for regulating the circadian rhythms in humans through hormone secretion, particularly melatonin, which is secreted most at night and suppressed when light is detected. Circadian rhythms are those in which physiological events recur approximately every 24 hours, often even in the absence of environmental cues. In addition to hormonal secretion, these physiological effects include significant changes in basic metabolism, body temperature, heart rate, and blood pressure, as well as telling the body when to go to sleep and when to wake up.

Studies have shown that people are physiologically designed (although less so than most plants and animals) according to such a “biological clock,” which is an internal time-measuring mechanism that has a biochemical basis. Environments that aren’t congruent with such human biorhythms tend to cause mood disorders
(see Nilsen, Hansen, & Olstad, 2004). For instance, the limited amounts of daylight in winter, particularly in areas far from the equator, cause what has been labeled seasonal affective disorder. This condition, even in relatively weak levels, has been shown to influence rates of depression, anxiety, and other clinical disorders that have been found to be correlated with criminal behavior (Ennis & McConville, 2004; Nilsen et al., 2004), and some of these links may be related to dopamine receptor genes.

An example is provided by Davies (1982), who found that assaults by prison inmates tend to be clustered at a certain time of day. Interestingly, that peak time is 11:00 to 11:30 a.m., which would correspond to the approximate midpoint of waking hours, as well as the time in which glucose levels likely hit their lowest point (Marks, 1976). A deficit of glucose (blood sugar, which can be seen as brain “fuel”) not only limits concentration and sound decision making, but also causes irritability and aggression, especially in hypoglycemics. So, for a variety of reasons, it is important to monitor inmates’ diets, which studies demonstrate can influence violent behavior in prisons (Brown, Esbensen, & Geis, 2006). Solutions include eating multiple meals throughout the day, rather than only two or three. Also, modern medicine has made significant progress in this area, particularly with drugs, such as the hormone glucagon, that stimulate the release of glucose. These are just two examples of possible links between circadian rhythms, glucose levels, and criminality, and they suggest that the pineal gland and related chemicals should be a target for future research.

Such research on the pineal gland and circadian rhythms seems even more relevant given that scientists have recently (February 2002) reported the discovery of new photoreceptor cells that actually reset the body’s master biological clock (Berson, Dunn, & Takao, 2002). Until now, scientists have always assumed that rods or cones in our eyes were responsible for both vision and this “resynchronizing” of our circadian rhythms. However, by observing animals and humans who were blind and without rods or cones, scientists now realize that there are actually two different systems in the eye: one for vision via rods and cones, and another for setting the clock that involves these new cells communicating with the appropriate brain structures, such as the pineal gland. This breakthrough is currently changing scientific knowledge about how light is received and interpreted by our nervous systems, and further implicates the pineal gland and the body’s biological clock as a potential source for affecting human behavior.

Additionally, it is also possible that the effects of the pineal gland and circadian rhythms may be more indirect, namely, through seasonal changes. To clarify, in some species of birds, the sex hormones are increased in the summer because of extended periods of light that is absorbed by the pineal gland. This increase in light tells the pineal gland to secrete less melatonin, which is secreted at night and, thus, suppressed by light. Without the hormone’s inhibitory effects, the gonads of the birds increase in size, which then causes numerous behavioral changes (e.g., migrating, singing, courting) related to mating. This type of cycle based on extended hours of light is called seasonal photoperiodicity and increases the likelihood that successful reproduction in many bird species will take place at the most optimal time.

Perhaps this same type of cycle in humans is related to the disposition and incidence of criminality. For example, studies have shown that the incidence of most
serious crimes increases dramatically in the summer and warmer months (see numerous years of data from the Department of Justice’s *Uniform Crime Reports*, which is also provided on a state-by-state basis; e.g., see State of New Jersey, 2004) and studies have also found that criminality is associated with higher levels of sex hormones, such as testosterone (Archer, 1991; Booth & Osgood, 1993; Olweus, 1987) or those related to menstrual cycles (for a review, see Fishbein, 1992). It is possible that one of the reasons for the increase in crime in summer and/or warmer months is due to the extended periods of light that limit the amount of melatonin that the pineal gland secretes, thereby allowing for elevated levels of sex hormones, which have been clearly linked with criminal behavior. Although there are other established explanations for the increase in crime during the summer (e.g., more opportunities), this does not mean that the influence of circadian rhythms can be ruled out. The criminological literature is silent about this possibility and, thus, should be examined in future research.

Another limbic-related structure that has received virtually no attention in the criminological literature is the *cingulate gyrus* (see Figure 5.3). Sitting atop the limbic region and corpus callosum, but covered by the higher cortical regions, the cingulate gyrus is in a great position to act as the brain’s “gearshift,” allowing it to transfer from one thought to another. It receives signals primarily from the thalamus and the cerebral cortex, but from other areas, too. It has been linked to several clinical disorders, including obsessive-compulsive disorder, as well as to disorders related to the prefrontal cortex (see below), basal ganglia, amygdala, and other structures (Damasio, 1994; Diamond, Scheibel, & Elson, 1985; Eccles, 1989). The anterior portion of the cingulate gyrus is the most responsible region for relating to the prefrontal cortex and areas of the limbic system, and it has been linked to the rage responses of individuals (Guyton & Hall, 2006). When working properly, the cingulate gyrus works toward flexibility and shifting attention—in other words, adaptability. Consistently, it also helps postpartum women facilitate maternal care and play, and regulate audiovocal signals.

When it is not working, the cingulate region causes excessive worrying and argumentativeness, which is largely due to inflexibility and an inability to adjust to environmental factors (Guyton & Hall, 2006). It is not surprising that abnormalities in the cingulate gyrus result in behavioral problems such as obsessive-compulsive disorder and road rage, both of which deal with chronic fixation on a regular ordering of the world, which almost never happens in reality. Individuals with an abnormally functioning cingulate region respond to environmental stimuli in an exaggerated, often criminalistic way that does not correspond to a normal disposition. Again, this mostly goes back to the ability to be flexible, which problems in the cingulate gyrus hinder. This results in a person becoming argumentative and uncooperative in situations that can be resolved easily.

In fact, some studies using an imaging technique called single-photon emission computed tomography have shown that if the cingulate gyrus region is not functioning properly, individuals may not be able to successfully handle anxiety or stress. Furthermore, this structure is especially important for criminality, because it helps regulate emotional responses, especially those regarding aggression and pain. It has been theorized that individuals with a malfunctioning cingulate gyrus can
actually get “stuck” on bad thoughts, and they can’t move past them in a healthy fashion (Begley, 2001a).

Additional research has shown how a deficient cingulate gyrus can even make an individual believe that he or she is hearing voices when the sounds are actually produced in one’s head (Begley, 2001b). On the other hand, in healthy individuals, this “reality-check” region is the structure that typically notifies us when we are dreaming. This structure examines the images we perceive and determines their authenticity. So, it is not surprising that when this structure is not working properly, an individual can believe that he or she is seeing or hearing someone who is really there. Furthermore, these images appear as real as the images you are seeing or hearing at this moment. Studies have shown that overactivity in this area is linked to chronic offending, particularly violent offenses, along with a diminished amount of activity in the prefrontal cortex and the left temporal lobe (see Begley, 2001b).

Studies examining sex variations in EEGs and regional cerebral blood flow have found that one of the most significant differences when individuals are posed with a problem to solve is that women had higher metabolism rates in the cingulate region than did men (Gur et al., 1995). Perhaps this is one step in understanding why women tend to make different (usually better) decisions when it comes to deviant behavior. Ultimately, we believe that the cingulate gyrus is a brain region that may be more involved in the development of criminality than would be suggested in the extant literature.

One mesolimbic structure that has been linked to deviant activity, particularly drug abuse and other compulsive behaviors (e.g., chronic gambling), is the nucleus accumbens, which is located in an area lateral to the septal region. This region is often referred to as the reward center of the brain, probably because this structure is strongly affected by the release of a neurotransmitter called dopamine, which communicates pleasure in the brain. The link between the nucleus accumbens, dopamine, and the frontal cortex of the brain is believed by many experts to be one of the key functioning systems in individuals’ sensation-seeking drive (often referred to as the behavioral activating system), which we will discuss in detail in the next chapter. Researchers have linked poor teen motivation to an underdeveloped nucleus accumbens; specifically, teenagers had less activity in this region during a gambling game, which therefore has significant implications regarding motivations and rewards (Bjork et al., 2004).

In fact, results from brain imaging studies show that this is one of the key structures implicated in the addiction to smoking tobacco, which research has shown to be the most addictive drug (and certainly the most deadly) in modern society. The nicotine creates sensations of pleasure via the nucleus accumbens by telling it to release dopamine. Notably, the nucleus accumbens appears to be one of the primary structures involved in pleasure seeking and thus is implicated in risk-taking behavior. This has become one of the premier personality traits in the criminological research (see Gottfredson & Hirschi, 1990), so the implications of a deficient nucleus accumbens are obviously an important area for future research regarding personality traits and disorders.

The anterior cingulate cortex is also shown by recent research to be one of the primary portions of the brain that becomes activated when painful events occur
This research has not only implicated this region for developing bonds and closeness in primates, but has also been found to be key in creating feelings of depression and anxiety when individuals were rejected in social situations. Therefore, given the extensive research on the cingulate cortex in regard to anxiety, depression, and adaptability, this remains an important area for future criminological research.

Also, the ventral striatum (which is part of the ventral tegmental area) appears to be an important limbic-related structure in the behavior of individuals. The ventral striatum receives input that is important for regulating the emotional input of various limbic structures. This structure has been referred to as the “crossroads” for where the emotional activity of the brain connects with the motor activities of the cerebrum. For example, in the diagnosis of bipolar disorder, the ventral striatum appears to be defective in the sense that studies show that overactivity in this brain region is related with an enhanced likelihood of individuals to lack judgment in how impulsive behaviors (e.g., sexual impulsivity, overspending) will affect their lives.

This brain structure was implicated in a recent study that showed that actually earning money creates happier feelings than simply being given it, such as through inheritance (Pagnoni, Zink, Montague, & Berns, 2002). This study demonstrated that simply having money does not produce the same feelings of happiness as actually earning it. This implies that the ventral striatum is not only important in reinforcement activity, but it is particularly important in the rewarding of earned activity. Studies have clearly shown that chronic offenders tend to be more motivated to change when given positive reinforcement than when they are punished. Therefore, the ventral striatum may be considered a key area for future research in regard to the feelings of reinforcement that seem to be important in rehabilitative techniques that are emphasized in most correctional programs. In addition to these issues, studies have shown that clinical disorders (e.g., bipolar disorder) are correlated with a significant reduction in gray matter in the ventral striatum region of the brain. Thus, any clinical attempts to address various disorders should consider the physiology of the ventral striatum.

One region in the midbrain that is strongly linked to the limbic system (as well as the frontal cortex), known as the ventral tegmental area (VTA), has been shown in recent research to be an important portion of the brain for stimulating desire or interest (Guterl, 2002). Not surprisingly, this structure is a primary area for initiating dopamine production (see Chapter 6), which is largely responsible for feelings of pleasure in the brain. When this area of the brain was excited, mice ignored food and other objects in order to search for other forms of stimulation. This shows that this region of the brain may govern the search for knowledge and new experiences. Interestingly, the VTA provides an important communication function between the frontal lobes, the midbrain, and the limbic/mesolimbic system (to the nucleus accumbens), so a weakness in the VTA can be extremely important in the functioning of many regions of the brain.

The ventral tegmental area is highly activated in persons who are highly aroused, such as people who are looking at the love of their life. Recent studies using brain imaging showed that when passionate lovers were aroused, their ventral tegmental areas were highly active, as was an associated area near the midbrain...
called the caudate nucleus (see Figure 5.5). The caudate nucleus is a large C-shaped region near the center of the brain linked to, among other things, the addiction to nicotine, which is found in cigarettes and other forms of tobacco). Furthermore, brain imaging studies have demonstrated that persons with attention deficit hyperactivity disorder have significantly less volume in the caudate nucleus.

Obviously, an impact or trauma to the ventral tegmental or caudate nucleus can have significant effects on behavior, particularly regarding emotions or affective responses, with many of the effects in these two areas being related to their direct impact on the production of brain chemicals called dopamine and norepinephrine. These chemicals are called neurotransmitters, and they will be discussed in detail in the following chapter. For now, it is only important to know that such chemicals are largely responsible for producing feelings of pleasure; thus, if there is a problem with the structures that produce such chemicals and resultant feelings, then the result can have profound effects on an individual’s behavior.

Strongly associated with the caudate nucleus, another important set of structures in the limbic region is the basal ganglia (see Figure 5.5; this chart actually makes illustrative connections with basal ganglia), which surrounds the limbic system and
aids in the integration of thoughts, perceptions, and bodily movement. As shown in Figure 5.5, basal ganglia consists of the caudate, the putamen, and the globus pallidus (Beatty, 2001). Perhaps most important, the basal ganglia helps regulate the transition between emotional feelings, such as anxiety and pleasure (e.g., falling in love). For example, these structures have been implicated in the states of shock that people feel during or after traumatic events, in the sense that people do not respond or feel during this period; in fact, people tend to become immobile or frozen in terms of both actions and rational thought. The basal ganglia has also been implicated in the occurrence of posttraumatic stress disorder, which reflects excessive activity in this structural system.

Interestingly, individuals with attention deficit disorder (ADD) are actually less likely to freeze during traumatic events, which brain-imaging studies suggest is due to an underactive basal ganglia, which in turn is likely due to significantly less brain volume in this structure (much like the caudate nucleus). On the other hand, it is believed that the low activity level in the basal ganglia is responsible for, using a noncriminological example, poor handwriting skills in ADD individuals because it requires a shift to fine motor activities, as opposed to print writing (a more smooth motor activity), for which those with ADD tend to perform much better. Studies have shown that medications that raise levels of dopamine (see following chapters) in the basal ganglia raise the activity in this structure, and thus persons with ADD are able to handwrite better, as well as perform better on other motor activities. Perhaps most importantly, recent studies have shown that the basal ganglia has profound effects on regulating (or not regulating) the anxiety levels in individuals, which are extremely important in the production and inhibition of criminality, and will be discussed at length in the following chapter.

Unfortunately, criminological research has not examined structural or functional problems with most of the brain regions discussed above, particularly those of the limbic system. However, it is very likely that trauma to or developmental problems in such structures and/or functions have significant influences on criminal tendencies. Obviously, one of our major recommendations in this chapter is to encourage much more research in these areas, because as it stands now, only indirect conclusions can be made.

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**BOX 5.2 The Continuing Saga of Stanley: Personality Dispositions**

Stanley’s early psychological development likely had a great impact on his offending career. Given the self-reported and officially documented information that we have of Stanley’s personality in his early years (i.e., ages 6–18) we have fairly good insight into his psychological dispositions at various stages. This information reveals that whereas Stanley had a relatively average intelligence (he scored a 104 on the Stanford-Binet IQ test at age 7 [100 is average]), he scored relatively low on mathematics, which indicates that he may have had problems in linear thinking. Such an observation indicates a likely deficit in problem-solving ability or left-hemisphere functioning, which could have a strong impact on Stanley’s ability to deal with conventional learning and/or
and/or functioning. Individuals who have such deficiencies tend to be predisposed to deviant behavior (Coren, 1993); however, Stanley did score relatively high in history, which suggests a tendency toward humanities and a right-hemisphere emphasis in his brain orientation. Nevertheless, this would further predispose him to a more nonlinear, holistic train of thought, which would again reinforce his opposition to most conventional, scholastic activities.

Furthermore, Shaw (1930, p. 190) noted Stanley's early rise and persistence of a sense of injustice, which is evident throughout Stanley's narrative of his life. Furthermore, he was “hypercritical” of others and rarely, if ever, took the blame for his actions. Rather, Stanley usually placed the blame for his own behavior on an external source, which recent psychological studies show is quite common among offenders (for a review, see Walters, 2002). Showing signs indicative of a low-functioning autonomic nervous system (which would likely warrant a contemporary diagnosis of ADHD), Shaw reported that Stanley often showed an excessive interest in attention (i.e., stimulus hunger). Additionally, he often readily made friends, but such relationships quickly dissolved, which furthered his already strong feelings of isolation, suspiciousness of others, and self-pity.

Regardless of whether these personality/psychological traits were due to genetics, embryonic/delivery complications, or environmental factors, it is clear that Stanley developed the above attitudes and that these remained with him for some time. Although empirical studies (see text) suggest that it is likely that all of the influences listed above contributed to Stanley's acquisition of such personality traits, what is important for this section is that he did acquire the traits of an individual who exhibits low self-control (Gottfredson & Hirschi, 1990). This is seen in Stanley's dispositions toward feelings of

never takes blame but readily blames others, readily makes friends and as easily breaks with them, . . . absorbed in his own ideas . . . . and relatively immune to suggestions from others, resentment of correction and resistance to direction, tendency to escape from unpleasant situations, . . . speed of decision. (Shaw, 1930, pp. 190–191)

Such aspects exemplify an individual with a low level of self-control, which is consistent with numerous recent studies and theoretical models that would predict Stanley to become a serious, persistent offender.

In addition to clearly exhibiting signs of low self-control, Stanley reported experiencing feelings of excitement and euphoria when committing offenses. For example, Stanley claims that “I got the thrill of doing the stealing” (Shaw, 1930, p. 53). Even when Stanley was placed in a relatively good foster home that he described as “like a sweet dream. . . the luxury seemed to dazzle and blind me” (pp. 18–19), he soon felt as if

there was something missing. . . . I longed to go back to my friends . . . and could play and romp and gamble and swear. . . . My adventurous spirit rebelled against this dry life, and it soon won out. . . . What's the use of having riches, if you can't enjoy life? (Shaw, 1930, p. 19)

This type of mentality was highlighted by Jack Katz (1988) in his book Seductions of Crime. Katz explains that much delinquency is due to the feelings of exhilaration and excitement produced during the commission of the crime. Stanley obviously got a “rush” or pleasurable feelings when he engaged in illegal activity. Such feelings are typical of delinquents, as Shaw points out in quotations from youths other than Stanley.

(Continued)
Conclusion

This chapter discussed the various regions and structures of the hindbrain, midbrain, and limbic system, with an emphasis on those that are most relevant in the development of criminality. This chapter provided a basis for understanding primal functioning, so that the following chapter, which deals with the more advanced (human) portions of the brain, namely, the forebrain or cortical regions, will make more sense to readers. Still, the more primitive and subcortical regions of the brain that we examined in this chapter are often directly influential in terms of human decision making and behavior.