

Introduction to Brain Structure and Basic Functions—Part II

Forebrain Formation, Trauma, and Criminal Behavior

The greatest discovery of my generation is that man can alter his life simply by altering his attitude of mind.

WILLIAM JAMES (1842–1910)

This chapter provides a follow-up to the previous chapter, in discussing the brain structures that have been found to be affiliated with criminal offending. As mentioned in the previous chapter, brain structure and brain function tend to overlap to some extent, but this chapter focuses on differences in brain structure, as opposed to those in brain function, which are dealt with in more detail in future chapters.

FOREBRAIN: CORTICAL REGION

Of all regions of the brain, the cerebral cortex (i.e., cerebrum) is the largest and most evolved, which is why it is often referred to as the neocortex or neomammalian complex (*neo* meaning “new”). The relative size of the human cerebrum is unique and extraordinarily large compared to that of all other animal species. It can be argued that it is this part of the brain that makes us human in the sense that it is the realm for our highest levels of reasoning and decision making, which is why the cerebrum is referred to as the “learning brain” (MacLean, 1990; Nuñez, Roussotte, & Sowell, 2011). Most (approximately 75%) of the cerebrum grows once the infant is outside the womb, which highlights the importance of postnatal care in ensuring healthy development. Furthermore, regions of the cerebrum develop at varying rates and, in some ways, never stop developing. As discussed

later in this chapter, studies have shown that the brain—particularly the regions of the cerebral cortex—continues to develop in many ways throughout life, largely due to the impact of environmental influences.

Lateralization and the Corpus Callosum

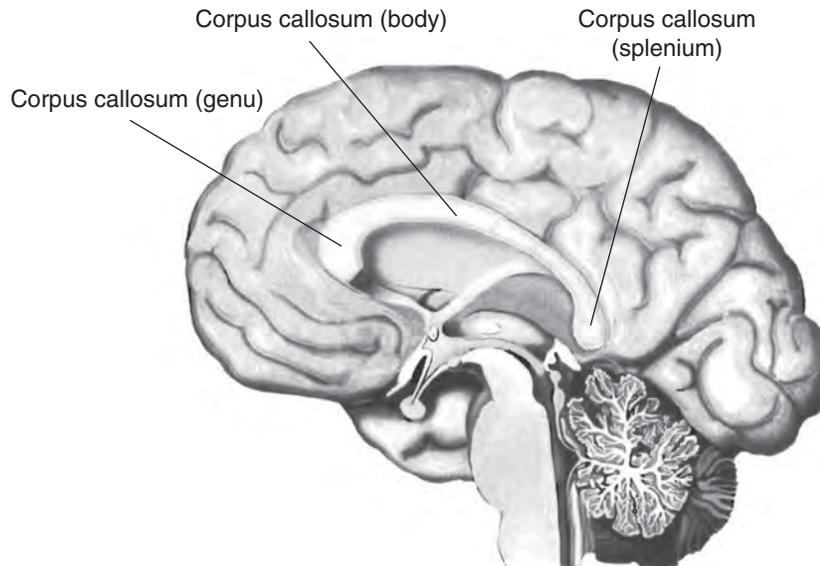
Like many other human organs that appear bilaterally symmetrical, the cerebrum is split into two halves—called hemispheres—each of which seems to be a virtual mirror image of the other. However, the differential functioning of each hemisphere is an important area of concern regarding the development of criminality. Specifically, researchers have found an association between criminality and persistent individual differences in the hemispheric emphasis in completing (or not completing) certain types of tasks, as explained shortly.

The left and right hemispheres are connected by a thick band of up to 800 million neural fibers called the corpus callosum (see Figure 6.1). As the largest fiber track in the brain, the corpus callosum carries the messages needed to coordinate and integrate left- and right-brain functioning. By acting as a bridge for communication between the two hemispheres, the corpus callosum plays a vital role in cognitive functioning and human behavior, which is significantly affected when this band is altered, damaged, or severed.

Some scholars (e.g., Hecht, 2011; Raine, 1993, 2013; Schalling, 1978) have suggested psychopathic criminal behavior may represent a partial interhemispheric disconnection syndrome, but very few studies have examined such a direct relationship. Although one study (Raine, O'Brien, Smiley, Scerbo, & Chan, 1990) using dichotic listening methodology did not confirm this proposition, the lead author later concluded that this “hypothesis is an interesting one warranting closer scrutiny” (Raine, 1993, p. 121). Raine’s reasoning is that because the corpus callosum is central to the transfer of information between hemispheres and plays an important inhibitory function, damage to callosal fibers may cause functional predominance of one hemisphere over the other, as well as other types of dysfunction. Despite a lack of research on the direct relationship between the corpus callosum and criminal behavior, there has been substantial growth in studies that have examined potential *indirect* relationships between this structure and dispositions toward criminality.

Although the corpus callosum has been traditionally difficult to study because of its irregular shape, modern use of magnetic resonance imaging (MRI) has enabled its study in living people rather than relying on autopsies. There is now a voluminous research literature examining the issue of whether the corpus callosum differs in shape, size, or some other way across certain groups, most notably males and females (for reviews, see Bishop & Wahlsten, 1997; Holloway, 1998; Raine, 2013). This research on sex differences regarding the corpus callosum has shown that human females generally have a significantly larger (relative to brain weight) and more bulbous structure than males (Hines, 1990; Steinmetz, Staiger, Schlaug, Huang, & Jancke, 1995). In fact, although it is unethical to employ hormonal manipulation with humans, studies with other species (e.g., rats) have shown that when female hormones are administered to newborns, the corpus callosum grows to a larger size (Fitch & Denenberg, 1998). These researchers also found that when pregnant female rats were given hormones, the corpora callosa of their offspring were significantly different in size. It is likely that hormones play a key role in determining the size of the corpus callosum in humans as well (Halpern, 2000; Webb et al., 2012). Studies have shown the corpus callosum is important in the acquisition of self-awareness and intelligence and that this cable of nerves continues to develop significantly into an individual’s later stages of growth, particularly through his or her teenage years and into his or her 20s.

Two commissures connect the neocortical tissue of the right and left cerebral hemispheres. Of these, the corpus callosum is by far the largest; the anterior commissure contains many fewer fibers. In addition, other commissures connect nonneocortical structures, such as the hippocampal commissure linking the right and left hippocampus.



One reason the size of the corpus callosum is important is that a number of researchers have implicated this size difference as a primary explanation for why female humans appear to have better connectivity between their left and right hemispheres and have been found to transfer information at a higher rate compared to males (Innocenti, 1994; Jancke & Steinmetz, 1994). Many researchers believe this enhanced transference of information between hemispheres is an important factor in the well-established sex differences in verbal ability, specifically that females are better than males in verbal fluency (Erickson, 2012; Halpern, 2000). From a criminological standpoint, research has long shown that individuals with low verbal abilities are more likely to commit various types of offending (Farrington, 2005; Gibson, Piquero, & Tibbetts, 2001; Raine, 1993, 2013; Wilson & Herrnstein, 1985). Research has also supported the vast differences between men and women in deviant activity. The implications of such sex differences in laterality patterns are discussed in more detail in Chapter 9. For now, it is important to acknowledge only that the size and function of the corpus callosum is of particular interest for understanding the development of criminality, especially in the context of sex differences and hemispheric specialization.

A special case should be noted regarding a mega-savant, Kim Peek, who was the inspiration for the main character in the Oscar-winning movie *Rain Man* (actor Dustin Hoffman was awarded the Best Actor Oscar for portraying this character based on Mr. Peek, and the film won Oscars for Best Picture and Best Director [Barry Levinson] in 1988). Peek was born without any corpus callosum, yet he was able to memorize an amazing amount of statistics and information regarding sports, history, literature, and dates. In fact, he could read both pages of a book at the same time, one with each eye, in a matter

of seconds, and was able to retain all of the information he read. At the same time, even in adulthood he could not button his own shirt or do many everyday activities by himself (which was also partially due to damage to his cerebellum [see Chapter 5]). So his father had to care for him until he died in December 2009, at the age of 58. It is likely that his lack of a corpus callosum led to his ability to be a true expert in memorizing and retaining statistics about virtually anything he wanted, but it also likely caused his inability to function in everyday life. Notably, his tested IQ score was only 87, which is below average, likely because he had difficulties with more applied questions, whereas his brain was more exceptional at pure memorization and retention.

Four Lobes of the Cerebral Cortex

Occipital Lobe

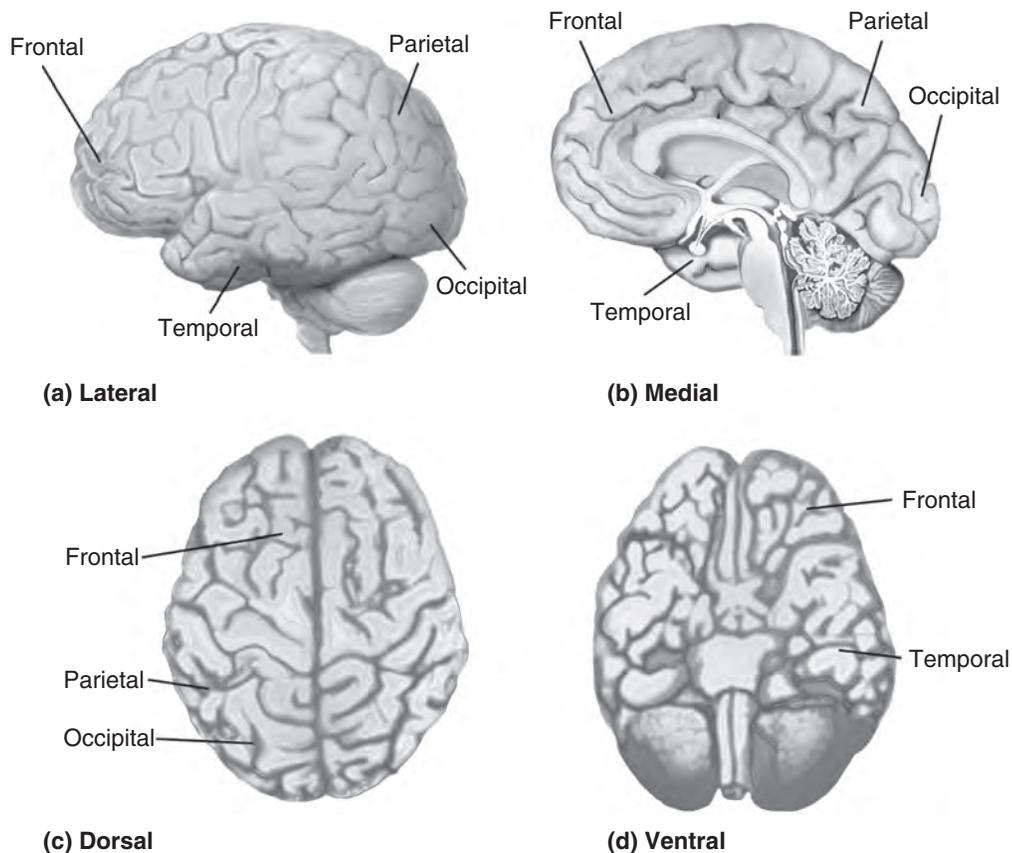
As shown in Figure 6.2, the cerebral cortex (as well as each hemisphere) can also be broken into four lobes or regions, each of which contains more specified areas and functions. The area at the lower back portion of the cerebral cortex, just above the cerebellum, is called the occipital lobe. The occipital lobe is primarily known as the home of the visual cortex, where sensory information from the eyes is processed and interpreted. Although this region is relatively less susceptible to trauma than other areas because of its location, damage to the occipital lobe can have profound implications. Such effects typically include visual impairments or blindness, but sometimes the trauma is related to clinical disorders and criminality.

For instance, trauma to the occipital lobe has been linked to the occurrence of visual hallucinations and illusions. Obviously, such psychosis-type effects can produce maladaptive, irrational behavior, particularly if such damage is not properly diagnosed and treated. Thus, it is not surprising that Virkkunen, Nuutila, and Huusko (1976) found that open head injuries to the occipital cortex were most predictive of high crime rates among soldiers, as compared to injury in other regions of the cerebral cortex. In fact, damage to the occipital lobe was more than twice as likely among criminals (11%) as was damage to the frontal or parietal lobes (4%).

Perhaps these findings reflect the importance of the occipital lobe in functions such as reading and writing. Obviously, proper functioning of the visual cortex is a key element in written communication and processing. Given the consistent links shown between low verbal ability and criminal offending (Gibson et al., 2001), it is not surprising that occipital lobe damage has been implicated in the development of criminality. The occipital lobe is also a key region (along with the parietal and temporal lobes) in the formation and retention of short-term memory, which involves organizing and retaining what one sees and hears. It goes without saying that short-term memory is an essential element in everyday functioning; those with poor memory are likely to have serious problems in life and may be inclined to resort to criminality.

Other links between occipital lobe injuries and offending may be due to the problems related to hallucinations and other visual illusions. Studies have consistently linked such psychotic symptoms with deviant behavior (Calzada-Reyes, Alvarez-Amador, Galán-García, & Valdés-Sosa, 2013; for a comprehensive review, see Raine, 1993). These are just some of the ways that damage to the occipital lobe can predispose individuals to criminal tendencies; future investigations must further specify the causal mechanisms involved in these links, as well as discover new ways in which the occipital lobe plays a role in criminality. Although some criminological studies have examined occipital lobe damage, virtually none of this research has been done recently, and it is apparent that more research is needed in this area.

FIGURE 6.2 Four Views of the Lobes of the Cerebral Cortex



Parietal Lobe

Another major area of the cerebral cortex is the parietal lobe, which is located in the central part of the cerebrum, near the back and top portion of the head (see Figure 6.2). Because of its close proximity to the primary motor cortex, the parietal lobe largely influences voluntary motor activities involving goal-directed movements and manipulation of objects. This area of the brain receives data from the skin and is the primary destination for signals of touch and sensation. Furthermore, the parietal lobe is known to be the area most responsible for integrating messages from our senses to create comprehensible representations of a single concept or memory.

As mentioned, the parietal lobe works with the occipital lobe and the upper temporal lobe in the formation of short-term memory. Another very important cognitive function of the parietal lobe is recognizing what an object is and where an object (or our own body) is in space, otherwise known as spatial processing (Kandel, Schwartz, & Jessel, 1991). Given these roles of sensory integration and spatial relations/positioning, it is not surprising that abnormal activity in the parietal lobe has been linked to schizophrenia (Rowe, 2002), which often involves perceptions of hearing voices or seeing

hallucinations. This function of spatial cognition is discussed further in Chapter 8, when we discuss sex differences in cognition.

Injury to the parietal region is more likely to occur than damage to the occipital lobe because of its location. Some of the problems observed when the parietal lobe is damaged include difficulty in naming objects, difficulty in distinguishing left from right, difficulty with drawing objects, and difficulty with math. Brain imaging studies (for a review, see Sowell et al., 2003) have demonstrated that individuals diagnosed with attention deficit/hyperactivity disorder show a significantly low volume of gray matter in the parietal lobe. This obviously affects their ability to perceive and respond to their environment, particularly when it comes to learning and adapting to their environment. These types of activities are very important in determining success in school and employment. As such, if there is a problem in the functioning of the parietal lobe, it can have detrimental effects on basic skills and abilities.

Although damage to the parietal lobe may be linked to criminality due to the functions already described, the most direct ties to chronic offending have been demonstrated by studies showing *higher* levels of activity in this region. As reviewed by Raine (1989), there is a substantial amount of evidence that chronic offenders, who generally exhibit low levels of arousal (e.g., stimulus deprivation), tend to show *more* arousal when presented with certain types of stimuli, particularly that of increasing intensity and interest. To further clarify, studies (e.g., Forth & Hare, 1990; Gao, Raine, & Schug, 2011) have found that chronic offenders actually show enhanced activity in the parietal lobe when presented with certain forms of stimuli, especially risky behaviors (e.g., gambling).

This phenomenon has been interpreted as a predisposition toward sensation seeking and is consistent with recently proposed theoretical frameworks (e.g., Gottfredson & Hirschi, 1990; Katz, 1988; Wilson & Herrnstein, 1985) that emphasize the seduction crime can have on individuals who tend to be risk takers. The evidence regarding the hyperstimulation of the parietal lobe in offenders appears to provide a physiological reason for why certain individuals appear to be oriented toward such risky behavior, such as violence. Still, researchers are quick to point out that even with such physiological tendencies, adequate steps can be taken to steer such risk taking and sensation seeking toward more conventional activities, such as “risky business ventures, the armed forces, or motor racing rather than crime and violence” (Raine, 1993, pp. 179–180), whereas others have noted the appropriateness of law enforcement for such personalities (Arrigo & Shipley, 2004; Eysenck & Gudjonsson, 1989). Another perspective is to focus on enhanced parietal lobe functioning, which would suggest steering young antisocials toward activities that involve advanced spatial abilities, such as mechanics or artwork (Gao et al., 2011; Raine, 1993). Furthermore, the amplified activity of the parietal lobe in chronic offenders may also partially explain why reinforcements (i.e., rewards) used in correctional treatment settings tend to show more positive results than the use of punishments (i.e., anxiety), which would be unlikely to have much effect on participants with low arousability.

Temporal Lobe

As shown in Figure 6.2, the temporal lobe can be found just above the ear on each side of the head, so it is not surprising that one of its primary functions is hearing and auditory perception. In fact, the region most responsible for speech comprehension—called Wernicke’s Area—can be found in the temporal lobe and is approximately the size of a poker chip in adults. It is to this area that auditory impulses are sent and processed for interpretation, often for storage as memory. Persons who sustain damage to the temporal lobe often experience difficulties in understanding spoken words, which is referred to as Wernicke’s Aphasia. Thus, the temporal lobe plays a key role in determining an individual’s aptitude regarding verbal communication.

Given the consistent findings linking poor verbal ability to criminality (for a review, see Gibson et al., 2001; Perkins, Smith-Darden, & Graham-Bermann, 2011), it is easy to understand the importance of healthy temporal lobe functioning for our purposes. It is also interesting to note that trauma to a particular side of the head may have differential effects because for most people, or at least most right-handed individuals, the speech center is located in the left temporal lobe, as opposed to the right. This issue is discussed further in Chapter 8, when we discuss laterality, or the tendency for certain functions of the brain to be housed in either the left or right hemisphere.

Auditory processing and speech comprehension are among the many important functions of the temporal lobe that likely implicate it in the development of criminality. The temporal lobe is very important for its relations to the brain structures in its proximity, namely, those of the limbic system. For instance, one structure found in the temporal lobe, the parahippocampal gyrus, plays a large role in the integration of internal signals with sensory information from the external environment (e.g., auditory, visual). This structure is obviously important for maintaining a healthy equilibrium in brain functions and is key in the process of categorization of objects and memory acquisition. Perhaps this is why temporal lobe damage has been linked to an inability to identify and verbalize objects, as well as to both short-term and long-term memory loss. Similar to these problems, one interesting manifestation of temporal lobe injury is experiencing great difficulty in recognizing faces, a phenomenon called prosopagnosia, which has been consistently linked with criminality and psychopathy (see Suchy, Whittaker, Strassberg, & Eastvold, 2009). Interestingly, recent news reports have revealed that Oscar-nominated actor Brad Pitt claims he has this disorder, also known as “face blindness,” because he has such a hard time remembering faces. So this disorder has become more mainstream and well known than in the past (for the story, see www.cnn.com/2013/05/23/showbiz/celebrity-news-gossip/brad-pitt-esquire-face-blindness).

Most importantly, abnormal (usually reduced) activity in the temporal lobe region has been strongly linked to schizophrenia (Rowe, 2002), as well as criminal behavior (Raine, 1993, 2013; Raine, Buchsbaum, & LaCasse, 1997). A series of studies has found an even more consistent association between temporal lobe abnormalities and sex offending, such as incest and pedophilia (Amador, 2011; Hucker et al., 1986; Langevin, Wortzman, Dickey, Wright, & Handy, 1988; Wright, Nobrega, Langevin, & Wortzman, 1990). Unfortunately, theoretical reasons for why temporal lobe dysfunction is linked to criminality are much less agreed upon, but strong arguments have been made that it is likely due to failure in the functions of the temporal lobe described earlier (e.g., poor speech comprehension, reduced memory acquisition). But this does not logically explain the even stronger association with sex offending, so other hypotheses must be considered.

One of the likely possibilities is that temporal lobe dysfunction is strongly linked to sex offending (whereas frontal lobe dysfunction is not) because of its close working relationship with the structures of the limbic system. Many of these structures, such as the amygdala and pituitary (see earlier), are the primary centers for controlling emotions and sexual drives. Consistent with this line of reasoning, research has shown that damage to the temporal lobe often significantly alters sexual drive and activity in humans (e.g., see Garnett, Nahmias, Wortzman, Langevin, & Dickey, 1988; Mosovich & Tallafarro, 1954; for reviews, see Raine, 2013; Reiss, Miczek, & Roth, 1994). Relatedly, temporal lobe epilepsy has been shown to cause personality changes, particularly aggressive rages (Blumer & Benson, 1975; Raine, 1993).

Another disorder that directly involves the temporal lobe is that of seizures, typically experienced by epileptics. A seizure is a sudden electrical disturbance of brain function that often results in uncontrollable actions and is typically accompanied by a loss of consciousness. These seizures are

found most commonly in individuals at the extremes of life—young infants and toddlers or the elderly—and they are generally caused by anything that tends to irritate the brain. Such irritants can include brain abnormalities present at birth, fever, tumors, anoxia (i.e., lack of oxygen to the brain), infections, or adverse reactions to toxic chemicals and drugs. The recurrence of seizures is clinically referred to as epilepsy, which has traditionally been linked to criminality even by the earliest criminologists (see Lombroso, 1876). More recent studies have also linked epilepsy in the temporal lobe to criminality (Pontius, 2001).

An electroencephalograph (EEG) is often done to confirm the diagnosis of seizure and help to pinpoint possible lesions for surgical removal, as well as to classify the type of seizure (e.g., tonic-clonic [grand mal] vs. petit mal) in order to determine which anticonvulsant/antiseizure drug to use in reducing the symptoms. For example, whereas grand mal/tonic-clonic seizures typically result in loss of consciousness followed by falling to the ground and rhythmic jerking as the body becomes stiff, petit mal seizures tend to involve a loss of consciousness but not falling to the ground; rather, the person becomes immobile for approximately 15 seconds and then continues activity as if there was no lapse. Other forms of epilepsy include juvenile myoclonic, which tends to run in families and causes a jerking of limbs without loss of consciousness, as well as temporal lobe epilepsy, which tends to involve making strange faces, twitching, or muttering while being awake but not knowing what is going on at the time.

In many individuals, the best alternative is a temporal lobectomy, which involves severing a specialized number of connectors between the temporal lobe and other regions of the brain (such as the limbic structures). Fortunately, such surgical procedures and/or antiseizure drugs are effective in at least reducing the frequency of seizures in the vast majority of individuals who undergo this form of treatment. On the other hand, many persons who suffer from seizures do not benefit from such medical treatment and are predisposed toward criminality. This may be due largely to the treatment's impact on the person's education and functioning, which would affect his or her abilities in school or at work.

Although it has not been directly shown, it is likely that the consistent findings regarding sex offenders and/or epileptics are largely due to problems involving the complex processes between the temporal lobe and the limbic system structures. This explanation is also supported by the fact that many researchers have noted the ambiguous nature of the results of brain studies, such as those using an EEG and certain forms of brain imaging. Specifically, given the imprecise nature of such instruments, what appears to be dysfunction in the temporal lobe region may be due mainly to abnormalities in proximate limbic structures, such as the amygdala. Because instruments like the EEG use measures only on the exterior of the skull, distinguishing which internal structures are responsible for results showing inactivity is virtually impossible. As more sophisticated technologies are incorporated into this area of research, more specified conceptualizations of the effects of lobe dysfunction can be developed, including functions done in conjunction with limbic structures, as well as those unique to the temporal complex. Currently, we can only say that temporal lobe dysfunction is consistently linked with criminality, particularly that which is sexual.

Frontal Lobe

Located right behind one's forehead (see Figure 6.2), the anterior portion of the brain is the frontal lobe, with the most anterior part of this lobe called the prefrontal cortex. Being the last area of the brain to develop in terms of both evolutionary and personal growth, the frontal cortex is the largest and most

distinguishing feature of the human brain, and it goes the furthest in setting us apart from other animals in terms of anatomical structure and cortical functions. Regarding its structural uniqueness, the prefrontal cortex makes up more than 30% of the human brain, which is relatively much more than that of any other species (Fuster, 1989; Walsh, 2002). The functional differences in humans, many of which are discussed shortly, are perhaps best demonstrated by studies in which the frontal cortex is removed from the brains of lower animals (e.g., reptiles) and their behavior continues virtually unchanged. The animals continue to eat, sleep, fight, and so on, largely because those functions do not necessarily involve higher reasoning.

To clarify, the frontal lobe in most other animals is relatively small and does little in determining behavior. On the other hand, the frontal cortex in the human brain largely represents humanity, in that it is most responsible for the very activities that make us so unique in abstract thought, intellect, and even personality. While being most responsible for our humanity, the frontal lobe is the most vulnerable to injury due to its location (Levin, Eisenberg, & Benton, 1991; Slawik et al., 2009) and is also the region of the brain most implicated in the development of criminality and other disorders (Kolb & Whishaw, 1990; Raine, 2013; Sundram et al., 2012). Notably, the frontal region of the cortex, which governs rationality, stays underdeveloped throughout the teenage years in individuals, possibly limiting judgment skills. We discuss the reasons for this in detail, but first we review some of the specific functions of the frontal cortex.

Besides being very important in the formation of memories and some motor activities, this region is likely what most people think of when considering the brain because it represents the highest order of thought processes in human beings. These thought processes, often referred to as executive cognitive functions (ECFs), include problem solving, abstract reasoning, concentration, spontaneity, speech production, and direction of goal-oriented behaviors (Giancola, Martin, Moss, Pelham, & Tarter, 1996; Griffin & Tsao, 2012; Longo, Kerr, & Smith, 2013; Mirsky & Siegel, 1994). For example, the frontal lobe is responsible for our consciousness, or knowing who we are and what we are doing within our environment. It is interesting to note that the prefrontal area is the last portion of the brain to mature in human development (because it was the last portion added in evolution), which can be seen in children not being able to develop self-consciousness until at least 18 months of age (Lewis, 1992). The role of the frontal lobe in the development of self-consciousness has important criminological implications that are discussed later (see Chapter 8), but this region of the brain has many other important functions.

One of these jobs is initiating activity in response to environmental stimuli. In other words, the frontal lobe is largely responsible for determining how well one can adapt to external obstacles, which is such a necessary part of success. Established proposed models of criminality (e.g., Buss & Plomin, 1984; Gottfredson & Hirschi, 1990; Patterson et al., 1989; Wilson & Herrnstein, 1985) have emphasized the inability of some individuals (often chronic offenders) to engage in efforts to improve their well-being, particularly if these attempts involve long-term exertion and go beyond their “here-and-now” orientation. Evidence has clearly shown that antisocial behavior may be characterized by cognitive difficulties in assessing potential consequences of behavior, as well as acting on such assessments (Newman, 1987; Newman, Kosson, & Patterson, 1992; Rodríguez-Bailón, Triviño, & Lupiáñez, 2012; Seguin, Pihl, Harden, Tremblay, & Boulerice, 1995; Shapiro, Quay, Hogan, & Schwartz, 1988; for more discussion, see Fishbein, 2001; Moffitt, 1993a). These traits are quite consistent with frontal lobe dysfunction, which studies (for a review, see Levin et al., 1991) have shown cause difficulties in both problem solving and ability to focus on tasks (i.e., attending), as well as an inability to plan a sequence of complex actions needed to complete multistep tasks (referred to as sequencing). For instance, prefrontal cortex dysfunction

has been consistently linked to attention deficit hyperactivity disorder (Barkley, 1997; Schmeichel, Zemlan, & Berridge, 2013). Furthermore, studies show there is a 20% to 40% reduction in gray matter in the prefrontal cortex region of the brain in individuals diagnosed with bipolar disorder.

At the same time, these same individuals tend to be stubborn and inflexible toward their environment, regardless of the characteristics of the surroundings, to the point of making those around them more hostile (Buss & Plomin, 1984; Moffitt, 1993b; Patterson et al., 1989). Experimental studies with animals, such as rats (Pallone & Hennessy, 1998), have demonstrated that regardless of whether the animals are peaceably or aggressively nurtured, those who had induced frontal lobe damage respond to other animals in a uniform way: They attack with vicious, lethal aggression when another animal is presented into their cage. Furthermore, the animals with frontal lobe damage exhibited a different form of killing that went beyond the utility of the act; for example, the animals often continued striking or biting the “victims” even after they were dead.

Although often not lethal or quite as violent, a relatively similar pattern is consistent with frontal lobe dysfunction in humans, which often results in loss of manners in interacting with others, high propensity toward violence, loss of flexibility in thinking, and severe mood changes. The neuropathology of the frontal lobes examined in a study of more than 2,100 offenders found that those individuals who had committed the most serious, chronic pattern of violent offenses were those who had the greatest degree of problems in the frontal lobe region (Pallone & Hennessy, 1998). Specifically, the incidence of neuropathology among homicide offenders (94%) greatly exceeded the incidence in the general population (3%). The authors point out that this is an approximately 3,200% increase for violence among those who have neuropathological problems in the brain, particularly the frontal lobe region (Pallone & Hennessy, 1998). However, the causal mechanisms of such a profound effect between frontal brain damage and criminality is often not obvious.

One of the most promising links is that people with frontal lobe damage have been found to exhibit little facial expression (Kolb & Milner, 1981) or little ability to use external cues to guide behavior (called associated learning) (see Damasio, Tranel, & Damasio, 1990). This latter deficiency is consistent with criminological models that hypothesize that impaired ECFs reduce the ability to interpret social cues during interpersonal interactions, which may lead to misunderstandings or differential perceptions in social situations (Damasio, Grabowski, Frank, Galaburda, & Damasio, 1994; Giancola et al., 1996). Such interpretation problems are particularly problematic among individuals who have been consistently abused or grossly neglected in childhood and therefore have developed a fast “trigger” for dealing with threats, even false threats (this is discussed at length in the next chapter). This issue of individuals eliciting negative responses from others around them is perhaps one of the more important in developmental theories of criminality and, therefore, is discussed in more detail in other chapters in this book.

Another job of the frontal lobe involves making decisions, often moral judgments, about actions in our daily lives. The healthy frontal cortex is constantly communicating with other regions of the brain, particularly the sensory and limbic systems, and is always receiving signals regarding such things as emotional impulses. The frontal lobe is responsible for organizing and controlling these emotional drives in an adaptive manner, through rational decision-making processes.

So, it is not surprising that modern brain scan studies on dreaming show the frontal lobes become inactive while the limbic structures show a very high rate of activity during these dream periods of sleep (Nofzinger et al., 2004). When we dream, our rational frontal lobes are not working properly, so we are not able to realize we often are experiencing something impossible or surreal,

which is driven by our memory (hippocampus) and emotional (amygdala) centers. This is also a reason why our dreams don't seem to make sense; our linear thought processes are not functioning, so the story line of our dreams is often distorted or unrealistic. Interestingly, the same type of brain activity pattern (low frontal/high limbic) is seen during acute schizophrenic episodes, in which individuals see visions or hear voices that appear as real as any actual reality. Again, rationality is highly dependent on the functioning of the frontal lobe region.

Obviously, frontal lobe trauma is likely to affect one's ability to control irrational emotional impulses, and studies have linked such damage to impulsivity and feelings of indifference to consequences of behavior (Damasio et al., 1990; Fishbein, 2001; Raine, 2013). Thus, it is not surprising research has found that individuals who have frontal lobe injury frequently experience a change in their personalities, often becoming short-tempered and aggressive (Blumer & Benson, 1975; Raine, 1993, 2013; Volavka, 1999). In another light, this may be related to research that shows cognitive-behavioral therapy (CBT) (see Van Voorhis, Braswell, & Lester, 2000) is the most effective form of therapy for criminal offenders and those with clinical disorders (e.g., depression), probably because it purposely engages the frontal region of the brain. For example, brain imaging studies have shown that CBT (Mayberg et al., 2005), which is essentially teaching individuals to think before they act, significantly affects the frontal lobe's functioning; thus, it actually does make individuals think before they act. Perhaps this is why such programs have been shown to be effective, particularly among teenagers, whose frontal lobes are still developing.

Box 6.1 Focus On

ADHD, PSYCHOPATHY, AND THE YOUNG BRAIN

Brain imaging studies (Sowell et al., 2003) have also helped identify which regions of the brain are most implicated in attention deficit hyperactivity disorder (ADHD). The frontal lobe (along with limbic-related structures [caudate nucleus and basal ganglia]) is one of the areas that exhibits the most significant differences with regard to this disorder. Specifically, the right ventral dorsolateral (front side) area of the brain shows large decreases in gray matter for individuals with ADHD as compared to normally developed brains. This may explain the lack of planning or long-term consideration that is so common in persons diagnosed with ADHD. Notably, the same studies (Sowell et al., 2003) showed a volume deficiency in the posterior temporal lobe, which is strongly linked to the limbic system (see the discussions in the previous chapter regarding these regions). Along with other disorders related to criminality, it is clear the structural development and functioning of the ADHD brain has an extremely important effect on the way one perceives and behaves, particularly in relation to criminality. Unfortunately, the number of

youths diagnosed with ADHD has increased exponentially in the past two decades (although many were improperly diagnosed), and the influence of such disorders on predicting criminality seems to be especially problematic among children in our society.

At the same time, you may have noticed that many of the descriptions of brain-functioning problems discussed earlier resemble the natural tendencies of young children and teenagers. Beyond clinical and neurological disorders, even among normally developing brains in this age group, there is good scientific reason for this seemingly erratic and irrational behavior. To clarify, individuals in their early teenage years experience alterations to their brain structure and processing that resemble many cognitive problems known to be predictive of offending and often associated with antisocial and psychopathic tendencies. Therefore, it should come as little surprise that teenagers are responsible for a very large percentage of crime in virtually all societies across time and place.

Specifically, the teenage brain involves a combination of factors in both structure and function that predispose teenagers toward impulsive behavior and low self-control. For example, the pituitary gland (see earlier), which releases large amounts of sex hormones, is very active in teens, resulting in extremely large amounts of androgens in males and varying ratios of estrogen/progesterone in females. Studies have consistently shown that these drastic fluctuations in hormones, particularly increases in testosterone and progesterone, cause cognitive propensities toward violence (see Booth & Osgood, 1993; Walsh, 1995; for reviews, see Fishbein, 2001; Rowe, 2002; Walsh, 2002). Thus, some experts have noticed the similarities between the functioning

of the youthful brain and the functioning of adult psychopaths, with the primary difference being that most people experience maturation of the cerebral cortex, which tends to inhibit such impulsive behaviors over time. Given that the most rational, inhibiting part of the cortex—the frontal lobe—does not fully develop until approximately the mid-20s, it is not surprising at all that teenagers behave irrationally and impulsively. So, to some extent, psychopathic behavior can be seen as manifestations of a brain that never structurally or functionally matured, at least in a normal and healthy way. This theory is consistent with that of Dr. Bruce Perry, whose theory of altered brain development we examine in subsequent chapters.

In addition to not yet having acquired a fully developed frontal lobe, teenagers also rely more heavily on the amygdala (the emotion center of the brain) in making behavioral decisions than do adults. On the other hand, the frontal lobe of the brain, which governs rationality and inhibition, stays underdeveloped throughout the teenage years. Additionally, the cerebellum remains undeveloped until the end of the teenage years; although a “primitive” hindbrain structure, it is key in successfully performing social tasks and learning. This is further exaggerated by the underdevelopment of the corpus callosum, which helps connect the two hemispheres and allows for more efficient problem solving and self-awareness. As you have probably guessed, teenagers have a more primal functioning brain in the sense they are directed more by their emotional center and hormones and less so by the rational (frontal) portion of the brain. So, it is not surprising that persons in this age group comprise, by far, the largest group of offenders by rate. An examination of the arrest rate by age, in any year for any society, shows the age-crime curve peaks at approximately age 17. This universal trend, especially to the extent it exists across all cultures for all years, would only be likely if there was a physiological difference in teenagers throughout the world. This physiological explanation does, in fact, exist.

To expand on this important stage of development, modern studies by Jay Giedd and his colleagues at the National Institute of Mental Health using magnetic resonance imaging (MRI) have shed extensive light on brain development, especially during the teenage period (e.g., Giedd et al., 1999; Giedd et al., 2009; also see Wallis, 2004, for a review of Giedd’s research). The longitudinally administered MRI photos of twins have shown that, although many experts claim earlier cessation of growth, the brain continues to grow significantly until at least age 25. This obviously has huge implications for policy in the sense that previous implementations assumed the brain was configured much earlier in life (see Walsh, 2002). It is now obvious that the brain does not reach structural formation until the mid-20s and furthermore, continues to be reconfigured throughout life, largely in attempts to adapt to the environment.

One of the most significant findings of Giedd’s research is the realization that although the brain is set by a genotype to be built a certain way, subtle changes occur in the gray matter structure based on environmental differences and experience. In Claudia Wallis’s (2004) review of Giedd’s research, she claims the brain is the most notable organ for which experience becomes flesh. We not only agree but believe this is one of the most efficient and profound claims in this book. It sums up the ironic fact that the brain is “hard-wired” to be “soft-wired,” in the sense that all normal developing brains are programmed to learn and adapt from their environment.

Giedd's studies have shown that in addition to the explosion of growth that occurs in the perinatal stage of brain development, there is a second stage of growth and weeding of neural paths that occurs in later childhood and teenage years. This involves not only the development of key synaptic paths but also the pruning of neurons and pathways not being used. Thus, if certain brain mechanisms are not being used, they will be eliminated due to prioritization in the brain. This results in a significant amount of nerve cells and synaptic connections being discarded, which distinguishes this stage from the prior stage of growth in the perinatal stage. This stage of discarding neural paths is referred to as "neural Darwinism," in which the fittest synapses survive and the least used synapses die. Thus, the educational and life experiences during the teenage years are quite crucial in the configuration of the brain for determining the structure and function of cerebral quality for life. After all, if you don't use it, you lose it.

Explaining "Neural Darwinism": Pruning of Neural Pathways

To elaborate, during the late childhood and early teenage years, the neurons grow in volume and a thickening of the gray matter occurs. At a certain point in the early to midteens, this gray matter starts to diminish because of the discarding of unused synaptic paths, which continues until an individual is in his or her mid-20s. During this midteenage period, there is extensive growth in white matter, which provides insulation and communication efficiency for the neural axons (Ladouceur, Peper, Crone, & Dahl, 2012). This process functions under the old premise of "quality over quantity" in the sense it makes the used neural paths more effective and quick, while getting rid of the paths not deemed as important (in that they are not being used). So, it is during the teens and early 20s that the brain becomes the efficient machine we use for the rest of our lives.

Examples of neural Darwinism have been documented by scientific research. Studies have shown that persons who depend on certain brain functions show not only improved function but also enhancements in key structures. For example, individuals who depend heavily on recalling geographic patterns, such as cab drivers, show a significant amount of growth in areas that aid in memory of such patterns, such as the hippocampal region (Wallis, 2004). In addition, research has shown that persons who start learning how to play the piano develop a thickening of neurons in regions of the brain that govern finger movement and coordination. It is not just the higher brain areas that are affected by this prioritization. Studies have shown that one of the key areas for neural Darwinism is a hindbrain region, the cerebellum (see earlier), which is one of the essential brain regions for learning from experience.

Although the lower and hindbrain areas are influenced by the pruning process, it is still the higher brain regions that experience the most effects, particularly the frontal and prefrontal lobes that are most affected, probably because of the back-to-front development of the brain. Notably, these regions are primarily responsible for problem solving and higher brain functions. Thus, the frontal region of the cerebrum is altered the most due to experiences and learning in the teenage years.

So, although the impact of hormones on decision making and behavior is extremely important in the teenage years (see subsequent chapters), there is a lot more going on in this age period than just a surge of chemicals. It is now clear that significant structural and functional changes are occurring that go well beyond hormonal levels. Specifically, the most rational parts of the brain and communication abilities are simply not fully formed until the mid-20s.

It should be obvious that when surging hormones (e.g., testosterone, progesterone) are present in the absence of developed higher functions of rationality, teenagers are highly susceptible to engaging in behavior that does not make sense and is often criminal. Furthermore, studies have shown for certain individuals experiencing early puberty that there are often large increases in developmental hormones

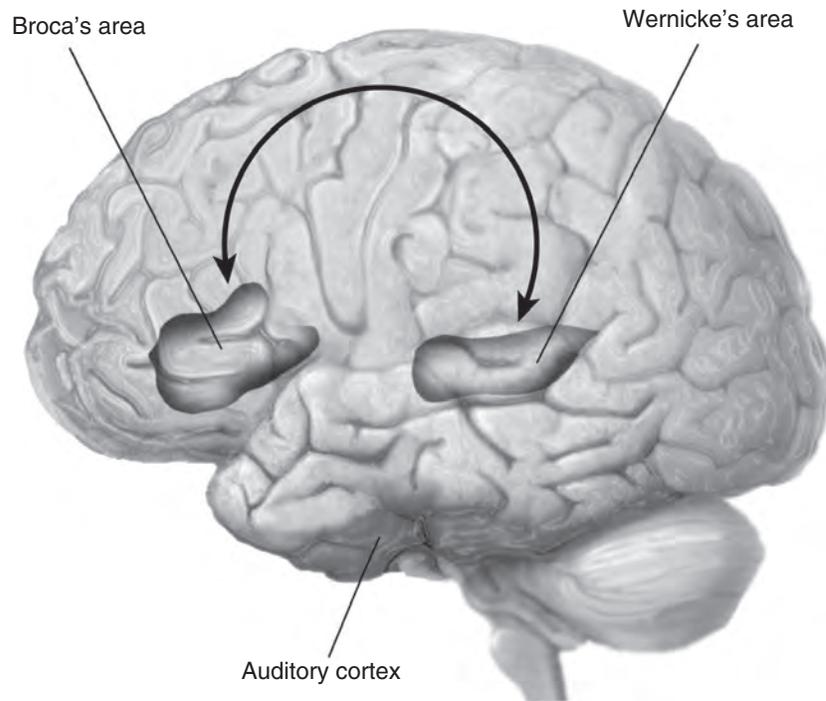
long before the maturation of the frontal lobes takes place, which even further increases their risk for criminality. A good example is provided by studies (e.g., Moffitt, Caspi, Belsky, & Silva, 1992) showing that females who begin menstruation early are far more likely to engage in criminal behavior than their late-onset counterparts.

It is a dangerous combination when raging hormones are telling a teen to take risks and engage in adult-like behaviors, while the appropriate parts of the brain have not fully formed to tell the individual what he or she is doing is irrational. Unfortunately, the hormonal surge of puberty and the development of the frontal lobes of the brain are not linked and appear somewhat independent of each other. Perhaps it is not surprising that studies show teenagers tend to identify pictures of persons in fear as being angry, which is believed to be one of the reasons why they often misinterpret emotional cues and feel people are angry at them when it is not true (for more discussion, see Wallis, 2004). Not surprisingly, teens are more likely to make risky decisions. For example, in an experimental driving simulation game, simulated drivers had to decide whether or not to run a yellow light (Steinberg, 2004). In this study, teens made safe decisions when alone, but when they were with others, they made more risky decisions than did adults when they were with others. This is not surprising, given that most delinquent offenses take place in groups of teens. Furthermore, adults tend to be able to make personal decisions, even in the presence of others, probably due to the further development of the higher brain areas.

Lobe Connections to Sensation Seeking

Returning to brain structure, the frontal lobe region is strongly linked to a structure called the ventral tegmental area (or VTA), which lies in the midbrain (the tegmentum region is shown in Figure 5.2). Research has shown that this region of the brain is responsible for our “seeking” drive, similar to Freud’s idea of libido in the sense it is believed to make us search for something unique (see Krebs, Schott, & Düzel, 2009; Solms, 2004, for a review; for further discussion, see Guterl, 2002). As an example of this sensation seeking, when the ventral tegmental is stimulated in rats, they will run around and even ignore food in the search for other stimulating objects. This area appears to drive our determination toward something new, but whether it be a Freudian libido effect or a “Coolidge effect” (i.e., sexual desire in males increases with different partners), experts are not sure. Regardless of how the effect occurs, the ventral tegmental appears to be very important in the seeking of new experiences and feelings. Thus, it is likely this region may differ in structure and/or function in chronic offenders as compared to nonoffenders because of the consistent finding that persistent offenders are more oriented toward risk taking, impulsiveness, and sensation seeking (for a review, see Pratt & Cullen, 2000). Differences in the VTA may also explain short attention spans in children diagnosed with attention deficit disorder. However, virtually no research has been directed toward examining this potential link, particularly for criminality.

The frontal region is also responsible for directing one’s motor activity once a decision has been made, the primary motor cortex being located near the posterior portion of the frontal cortex, bordering the parietal lobe. This is why individuals with frontal lobe damage often have loss of simple or fine movements of some body parts, such as hands and fingers (Kuypers, 1981). Frontal lobe dysfunction has also been linked to fewer spoken words and other verbal communication deficits (Chan et al., 2013; Kolb & Milner, 1981), which is consistent with the finding mentioned earlier that frontal cortex dysfunction is related to fewer facial movements in social situations. Further, the center for speech production, known as Broca’s area, is also located in the frontal cortex (see Figure 6.3), and damage to the frontal lobe has been consistently linked to an inability to express language (called Broca’s aphasia). Given the consistent association between low verbal skills and criminality demonstrated in the extant literature (for a review, see Gibson



et al., 2001; Lopez-Leon & Rosner, 2010), this is another reason why the frontal cortex is so important in terms of deviant behavior. Sometimes, individuals with frontal lobe dysfunction do well on IQ tests despite their condition, probably because of traditional tests' emphasis on assessing convergent rather than divergent (e.g., problem solving) thinking abilities, with only the latter being significantly affected by the frontal lobe. Thus, it is important to keep this in mind when screening individuals for potential problems related to frontal lobe dysfunction, and it may be necessary to use more sophisticated instruments, such as brain imaging techniques.

Structural and Functional Issues Regarding the Prefrontal Cortex

Of all the regions of the brain, dysfunction of the prefrontal cortex has been most directly linked to aggressive behavior, as well as to personality changes toward impulsivity and irritability (Kandel & Freed, 1989; Nomura, 2011; Volavka, 1999). Furthermore, brain imaging techniques, such as positron-emission tomography (PET) and magnetic resonance imaging (MRI), have provided support for this position. Specifically, some studies show brain activity (as measured by glucose metabolism) is significantly lower in individuals who are persistently impulsive and/or aggressive (Goyer et al., 1994; Nomura, 2011; Raine, Buchsbaum, et al., 1997; Zametkin et al., 1990; for more details, see Fishbein, 2001; Rowe, 2002).

Structural differences in the prefrontal cortex, as measured by MRI, have been noted by Raine, Buchsbaum, and their colleagues (1997). Specifically, the researchers found that antisocial

individuals had significantly less (11% less) gray matter in the prefrontal area than did the controls, but there was no difference in the white matter (Raine, Lencz, Bihrlé, LaCasse, & Colletti, 2000). To clarify, gray matter consists of the clusters of cell bodies and their nearby synaptic connections in the nervous system. For example, the surface layer of the cerebral cortex has a gray appearance because large numbers of cells are packed together. White matter, on the other hand, refers to axon tracts, the bundles of extensions that project from the cell bodies and send their output to other neurons; these axons are covered with a fatty sheath (called myelin) that gives them a whitish appearance (Halpern, 2000).

Beyond the structural aspects already discussed, there are also significant differences in the functioning of the prefrontal cortex in offenders. A study using PET showed glucose use and blood flow measurements in the prefrontal cortex were abnormal in violent individuals and that these abnormalities tended to be in the left portion of the cortex (Volkow & Tancredi, 1987). Furthermore, several studies by Adrian Raine and his colleagues (Raine, Buchsbaum, et al., 1997; Raine, Meloy, et al., 1998; Raine, Phil, Stoddard, Bihrlé, & Buchsbaum, 1998) have demonstrated reduced prefrontal glucose levels among murderers. Interestingly, some of Raine's studies have discovered more abnormalities in glucose usage for murderers who had no history of child abuse or neglect, which suggests the functional problems in some violent offenders are so influential they do not require an environmental trigger. Some experts have claimed this reflects a taxonomical path in which impulsive murderers (as opposed to premeditated, predatory murderers) are predisposed to commit such offenses due to abnormal neurobiology, namely a prefrontal cortical dysfunction (Volavka, 1999). Thus, both the structure and functioning of the prefrontal cortex have been found to be significantly different in individuals who consistently show aggressive behavior.

Research has also demonstrated that such structural differences are largely due to genetic differences. For example, using brain scans of twin pairs (monozygotic and dizygotic) and unrelated subjects, Thompson et al. (2001) found the distribution of gray matter across the cortex is under significant genetic control, particularly the frontal cortex and the primary language areas such as Broca's and Wernicke's regions (see Figure 6.3; for more discussion, see Chapters 7 and 8). Furthermore, Thompson et al. found the quantity of frontal gray matter was strongly related to individual differences in IQ. Thus, Thompson et al. (2001) concluded the brain maps revealed "a strong relationship between genes, brain structure and behavior, suggesting that highly heritable aspects of brain structure may be fundamental in determining individual differences in cognition" (p. 1). Other brain scan studies have discovered similar genetic influence in the structure of several regions discussed earlier in this chapter, such as the corpus callosum (Oppenheim, Skerry, Tramo, & Gazzaniga, 1989; Pfefferbaum, Sullivan, Swan, & Carmelli, 2000), as well as the overall volume of the brain itself (Tramo et al., 1998).

Studies have further implicated the right ventral prefrontal cortex (RVPC) in mediating the pain response from being rejected in social situations (Eisenberger, Lieberman, & Williams, 2003). This research has shown feelings of pain from social rejection are quite similar to feelings of physical pain, which the RVPC region also helps to inhibit. Therefore, trauma or abnormal functioning in this region would tend to exaggerate such feelings of pain, whether due to physical or social origin. So, such problems with functioning in this region are likely to produce problematic behavior, especially in terms of criminality.

Although the frontal lobe, particularly the prefrontal cortex, is particularly vulnerable to injury and the structure most often associated with developmental problems, it appears to be the most "plastic" area of the brain. This means the synaptic paths of communication are relatively flexible in this region in that they are essentially in a dynamic state of change, ready for learning new ideas and behaviors. Even

Thompson et al. (2001) and other brain scan researchers discussed earlier have noted the importance of environmental influences on brain structure and function that go beyond the genetic, heritable influences. The good news is this means that, in many cases, these communication paths can be reconfigured significantly with the proper treatment. Ultimately, this gives a sort of physiological reason to have faith in correctional programs, particularly those based on cognitive-behavioral models of therapy (see Van Voorhis et al., 2000).

Furthermore, the findings of these studies on the frontal cortex are even more intriguing when we consider the results of a study by researchers at the University of Wisconsin's Lab for Affective Neuroscience (Jackson et al., 2003). The authors of this study were primarily concerned with identifying the areas of the brain that cause some individuals to be consistently optimistic, despite stressors that present themselves in life, compared to other individuals who tend to always be pessimistic and have consistent negative dispositions, regardless of how well their lives may be going. This study used advanced brain imaging technology to identify the specific area that serves as the center for positive and happy feelings. The researchers concluded that the brain region most responsible for optimistic and happy feelings was the left prefrontal cortex. The left frontal lobe is one of the most likely to suffer trauma because of its location; a majority of individuals are right-handed, so if a blow is struck to the head, it is most likely to hit the left frontal lobe. It is rather ironic that one of the most important regions of the brain with regard to both cognition and criminality is also likely the most vulnerable to damage because of its location.

Unfortunately, this is consistent with studies already discussed showing that trauma to the left frontal area of the brain is most predictive of future criminal activity. It is quite likely persons who experience such trauma become less happy (or more negative) with life, and this may help explain why such individuals are so much more likely to commit deviant acts. Studies have shown that people who have strong activity in the left frontal region of the brain tend to be more optimistic and positive in their outlook, as well as to report feeling happy (Davidson, Shackman, & Maxwell, 2004); those who do not have this capacity will naturally be more predisposed to engage aggressively when interacting with others. This may explain why individuals who do not have healthy left frontal functioning are more prone to have a negative attitude about society and life in general and are more apt to commit antisocial acts.

The Continuing Saga of Stanley

Early Child Rearing

As mentioned before, Stanley's treatment by his parents in his early years was miserable. Stanley himself claimed that "as far back as I can remember, my life was filled with sorrow and misery" (Shaw, 1930, p. 47). One important factor was that Stanley's natural mother was "sickly," and she died of tuberculosis when Stanley was 4 years old. Thus, it is not surprising when Stanley says,

I never knew a real mother's affection. My father remarried when I was five years of age. The stepmother who was to take the place of my real mother was a rawboned

woman, devoid of features as well as emotions. . . . To this day I wonder how my father could have picked out such a woman for a wife. (Shaw, 1930, pp. 47-48)

Needless to say, Stanley's relationships with maternal figures were grossly inadequate. Numerous theoretical frameworks and empirical studies (Gottfredson & Hirschi, 1990; Hall, 1954; Hirschi, 1969) have consistently shown that such substandard nurturing at young ages greatly increases the likelihood of faulty psychological and sociological development.

According to official documents, his stepmother was physically and emotionally abusive toward Stanley, as well as other children in the household. Stanley reported that his stepmother was

a hell-cat full of venom and spite. The first time she struck me was when I was playing with the cat. . . . She beat me, striking me in the face and on the back with her hard and bony hand. . . . After many beatings, I became more and more afraid. . . . I became unhappy. (Shaw, 1930, p. 49)

Such excessive beatings have been linked with future disciplinary problems in children (Straus, Gelles, & Steinmetz, 2006), as well as other developmental problems (e.g., neuroticism, depression, low self-esteem). Additionally, Stanley's father never seemed to notice his new wife's treatment of the children, which was consistent with his general attitude of indifference toward them. Stanley claimed, "My father gave me no comfort. He spent his time at work, at the saloon, and in bed. Never did he pet or cheer me" (Shaw, 1930, p. 49). Studies (Gottfredson & Hirschi, 1990; Hall, 1954; Straus et al., 2006) have consistently shown that such emotional neglect (not just physical abuse) by caregivers has profound implications for a child's development.

Unfortunately, according to Stanley, all his father cared about

was his regular meals, a bed to sleep in, and his daily can of beer and whisky. His mind was like a motor, always on one course. He didn't think of his children as boys and girls to be loved. He thought of us as just "kids" who had to be provided for. . . . There his parental duties ended. Never did he show love or kindness. (Shaw, 1930, pp. 48–49)

Furthermore, his father was frequently drunk and often became abusive toward Stanley's stepmother in front of the children. Social learning models (Akers, 2000; Bandura, 1979) stress the profound influence of the modeling of violent behavior, especially when those observing such activity are young children.

Most surprisingly, Stanley reported that his stepmother actually encouraged him to go out and steal valuable items. Stanley elaborates on this point by describing incidents when he was 6 years old and he returned home with food and other items from boxcars he had broken into. His stepmother's

typical reaction is shocking: "After we arrived home with our ill-gotten goods, my stepmother would meet us and pat me on the back and say that I was a good boy and that I would be rewarded" (Shaw, 1930, p. 53). Such positive reinforcement and encouragement from his stepmother was likely very damaging to Stanley's development and is a perfect example of what not to do according to most theoretical perspectives (Akers, 2000; Skinner, 1953; Sutherland, 1947) and empirical studies (for a review, see Akers, 2000).

This poor treatment of Stanley continued for several years, during which time he became a chronic (or, in Stanley's words, "professional" [Shaw, 1930, p. 64]) runaway to escape such conditions. Finally, after being picked up by police dozens of times, Stanley had committed enough delinquent acts to be placed in the Chicago Parental School at age 9. This started a series of intermittent placements in institutions (e.g., Chicago Detention Home, St. Charles Training School, Illinois State Reformatory, the House of Correction) and foster homes that largely became his new guardians. Stanley had no feeling of loss in being removed from his family. In fact, when he was released from the Parental School, Stanley said he felt that

I was sorry when my stepmother came to the school to take me back home, or the place I wanted to stay away from. I had come to like the place [the School], at least, more than I did the hole to which I was returning. (Shaw, 1930, p. 201)

In a few weeks, Stanley was back in an institution because he kept running away and living on the streets.

It is also important to mention at this point that Stanley's neighborhood was one of the most disreputable areas of Chicago. This area was known locally as the "Back of the Yards," which literally bordered the Union Stock Yards and the central manufacturing district in the years when Stanley was young. According to Shaw (1930), "It is one of the grimmest and most unattractive neighborhoods in the city . . . comprised largely of unskilled laborers. The air in the neighborhood is smoky and is always filled with a disagreeable odor" (p. 34). Such poverty and dilapidated conditions are likely to increase the desire of residents to move out of the neighborhood.

As an important case in point, we will see that Stanley eventually fulfills his dreams by moving out of a decrepit area. This high level of transiency into and out of this neighborhood (as well as the generation gap between foreign-born

(Continued)

(Continued)

parents and their native-born children so prevalent in the early 1900s) was influential in breaking down any social organization that may have existed among the residents. Theoretical frameworks and empirical studies have consistently linked this type of social disorganization with higher delinquency rates in neighborhoods (Sampson & Groves, 1989; Shaw & McKay, 1942).

Several causal mechanisms have been identified for explaining why delinquency thrives in these neighborhoods with low social disorganization. As Shaw points out,

In the light of the disorganized community situation back of the yards, the persistence of a high rate of delinquency is not at all surprising. With the marked

changes in the composition, diffusion of divergent cultural standards, and the rapid disorganization of the alien culture, the continuity of community traditions and cultural institutions is broken. Thus the effectiveness of the community in the control and education of the child is greatly diminished. (Shaw, 1930, p. 37)

Furthermore, this breakdown in control allows for youths to be “educated” in an alternative and dangerous fashion: Children learn rules of the street from older children. This process whereby youths learn delinquent traditions from older youths on the street is examined in detail in the next section of the Saga of Stanley.

CONCLUSION

This chapter discusses the regions and structures of the brain, with an emphasis on those most relevant in the development of criminality. If one thing has been established clearly at this point, it is that many complex processes are occurring in the brain all the time and that any type of damage or trauma to such brain structures can have a devastating impact on perceptions and behavior, particularly in terms of criminal offending. Furthermore, even if the brain structure is adequate and healthy, many individuals experience problems with the way their brains function. Thus, the processes occurring in the brain are further complicated and affected by the hormones, neurotransmitters, and other functional activities continuously altering the way we interpret and adapt to our world. Such issues and problems in brain functioning are examined in the following chapter.