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## Neuropsychological Factors in Violence and Aggression

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We have chosen to view aggression in humans as a result of free will or under the control of the environment. However, it has become increasingly clear that if we truly wish to understand aggressive behavior, we must understand how it arises from neural structures and, more importantly, how dysfunction of those structures can lead to aggression. While there is no evidence to suggest that aggression is solely the result of neurobiology, its role is likely much larger than is generally acknowledged. Studies have increasingly recognized the importance of these factors, especially in individuals with histories of recurrent aggressive episodes.

Neuropsychology is the study of how brain processes influence and change behavior. Neuropsychological studies use a wide variety of measures to evaluate cognitive and personality changes that accompany injuries or changes in the brain. Neuropsychologists evaluate basic functions, such as motor and sensory skills, as well as more developed skills, such as intelligence, reading, writing, memory, speech, psychosis, depression, insight, awareness, flexibility, and problem-solving abilities.

The social implications of increasing violence necessitate a thorough understanding of the neuropsychological indicators that may lead to new ways to control or predict aggressive behavior. Neuropsychological factors appear to predispose certain people toward violence. This predisposition interacts with the client's environmental and social milieu. A violence-prone person raised in a hostile atmosphere will be much more likely to engage in violence. A violence-prone individual raised in a setting that appropriately acts to control violent acts may show less violent behavior.

In some cases, where the neuropsychological tendency toward violence and acting out is extremely high, the environment may play a negligible role. In cases where there is no unusual tendency toward violence, the environment may play the only role in determining the occurrence of violent and aggressive behavior.

## Neuropsychological Theories of Aggression

In order to fully understand how neuropsychological factors may predispose people toward violence and aggression, we need to identify those mechanisms which influence such behavior. There are multiple neuropsychological mechanisms involved in this process. Jones (1992) has identified four ways in which brain function can lead to aggression: (1) increased arousal interfering with the ability to think; (2) decreased ability to inhibit impulses; (3) impairment of attention, concentration, memory, and higher mental processes; and (4) misinterpretation of external stimuli and events.

These mechanisms point to impairment of specific areas of the brain. Most approaches emphasize one or more of the following areas: (1) damage to the very front of the brain, which is called the prefrontal cortex; (2) damage to the temporal areas of the brain (located around the sides of the brain), which include the emotional centers called the limbic structures; and (3) more extensive impairment to the brain arising from generalized damage to the brain as a whole, resulting in dementia or delirium. Although the problems in any individual may involve complex relationships between these areas, we will treat them as independent disorders for this chapter.

### Frontal Lobe Functions

Luria (1980) characterized the frontal lobes as the seat of higher abstraction, judgment, planning, sustained motivation, and self-regulation. The frontal lobes are the last areas of the brain to fully develop. Substantial changes take place in these areas during adolescence and into one's early twenties (Golden, Zillmer, & Spiers, 1992). While intellectual and cognitive skills are relatively well established by age 12 years, these frontal lobe skills are responsible for the changes that enable individuals to move from being children to being responsible adults.

The general functions of the frontal lobes include: (1) deciding what is worth attending to and what is worth doing; (2) providing continuity and consistency of behavior across time, central to planning and predictability of behavioral responses; (3) controlling emotional and interpersonal behavior so that drives are satisfied within the constraints of reality; and (4) monitoring, evaluating, and adjusting behavior (Hart & Jacobs, 1993).

It should be emphasized that prefrontal development, like the development of most higher levels of the cortex, is not dependent on neurological development alone. While biology provides the neural foundation for developing the skills mediated by the prefrontal areas, learning and experience must also take place so

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that the proper final structures are developed. Thus, unlike most organs of the body, development is dependent not only on the physical environment and DNA, but also on psychological and cognitive influences.

In an overview of neuroanatomy and neuropathology, Stuss and Benson (1984) described six specific manifestations of prefrontal damage. The first is an inability to use knowledge to regulate behavior. This means that although we may be aware that a behavior is wrong or inappropriate, we are unable to stop ourselves from doing the behavior. In such cases, what one thinks and says may be at odds with what one does. The prefrontal areas are important for turning what we want to do into our actual behavior, especially when what we want to do is at odds with our impulses (e.g., when we are angry at someone).

The second symptom is an impaired ability to handle sequential behavior. Specifically, people with prefrontal injuries are unable to follow a series of instructions. Thus, if they are taught a series of steps for anger management or what to do when threatened by someone else, they can follow the first or second step, but not the remainder of the sequence of behaviors. As a result, their ability to use socially approved methods to handle anger, challenge, or distress can be substantially damaged.

The third symptom is a tendency toward inflexibility. Inflexibility interferes with the client's ability to change their mind and to approach problems in different ways. This can influence aggression in two ways. In the first, the client uses problem-solving methods that are ineffective. This leads to increased frustration and emotional behavior. When someone tries to help, the client is unable to learn and becomes more hostile and aggressive. The second mechanism occurs when the client develops negative or paranoid ideas. These ideas usually involve the belief that someone is against or out to hurt him or her. Even when the client is shown that this isn't true, however, the client is unable to give up his or her belief. They continue to interpret anything the person does as supporting this belief. As anger escalates in response to this belief, violence becomes more likely.

Prefrontal injuries can also cause the opposite problem: the inability to maintain a mental set. Thus, the person may be erratic in mood and behavior. These frequent changes in mood or behavior can irritate others, leading to confrontations that may escalate into violence.

Individuals with prefrontal injuries may also be impaired in their ability to monitor their own behavior. Monitoring skills are important because they allow us to see whether our behavior is happening as we intend it to happen, as well as allow us to evaluate the impact of our behavior on others. In such cases, playful aggression may turn into violence as the person fails to see how his or her behavior is escalating.

In other cases, unintended insults and other irritating behaviors go unnoticed by the client, but set off confrontational behavior in others. The prefrontal client is unable to deal effectively with the confrontational behavior, leading again to possible aggressive behavior which the client sees as being solely instigated by the other person or persons involved. Individuals without monitoring skills are generally seen as having poor awareness and poor insight.

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A final defect seen in prefrontal clients is apathy. These clients, however, are very unlikely to be aggressive or violent. They generally ignore even provocative situations, and, in extreme cases, may be content to sit in one place for hours at a time. The clients generally fail to recognize that there is any problem with these symptoms.

These cognitive deficits may occur in an individual with normal intellectual abilities (Mattson & Levin, 1990). Thus, the person may superficially appear to be normal. The most typical form of expression of violent behavior arises from an intermittent period of irritability that escalates into an emotional response, the magnitude of which is quite disproportionate to the eliciting event (Wood, 1987). Such behaviors generally have a clear cause, although the cause does not justify the severity of the response.

Afterward, while clients may express sorrow for their behavior, they generally have little insight and see others as provoking the aggressive act. In many cases, they will be unaware of the severity or the impact of their response. Such individuals are generally highly egocentric and unable to appreciate damage or pain to anyone but themselves. They are unable to show a long-term understanding of the impact of their behavior or its implications for future behavior. Consequently, behaviors are likely to be repeated.

However, frontal lobe impairment does not always lead to violence or aggression. Indeed, the literature makes it quite clear that frontal lobe clients vary considerably from one another (Hart & Jacobs, 1993). The expression of a frontal lobe disorder appears to be substantially affected by the timing of the injury, the severity of the injury, the cause of the injury, and the nature of the person's pre-morbid personality.

In the case of many individuals, pre-morbid tendencies toward aggression or irritability become expanded as frontal lobe controls are lost. In general, individuals who are older when injured and have well developed internal control systems show less of an impact than those with poorly developed internal controls. Not surprisingly, younger people, who have had no chance to develop controls, and older individuals, who have weak controls, are the most likely to show these symptoms.

Because prefrontal patients may be intellectually intact, they can be well aware that violence is inappropriate behavior. However, they are unable to use such abstract ideas in modulating or changing their own actions. When made aware that they have violated commonly accepted rules, their tendency is to place blame on others, due to their inability to see their own responsibility.

### Temporal Lobe Dysfunction

Temporal lobe impairment is often demonstrated by episodes of unprovoked or exaggerated anger, memory and intellectual impairment, auditory or visual hallucinations, delusions, and receptive language impairment. Episodic dyscontrol is most commonly associated with damage to the deeper portions of the temporal lobes, which contain limbic system structures important for regulating emotion and behavior (Miller, 1990).

Episodic dyscontrol was first described by Kaplan in 1899, when he demonstrated that it sometimes follows head injury. Meringer and Mayman (1956), who originated the label of episodic dyscontrol, noted that individuals who had a history of illness or injury involving the central nervous system were often subject to recurrent acts of rage in response to minor provocation.

Episodic dyscontrol, however, is not a specific disorder, and can be found in a variety of diagnostic categories, including psychoses, neuroses, borderline personality disorders, conduct disorders, psychopathy, organic brain syndromes, epilepsy, mental retardation, metabolic diseases, and in developmental syndromes including attention deficit hyperactivity disorder (ADHD) and specific learning disorders (Elliott, 1992). In each of these cases, the etiology can be emotional or due to neurologic impairment.

The clinical presentation of episodic dyscontrol varies in severity and form. In more severe cases, the aggressive behavior can appear as sudden, unprovoked outbursts that are primitive and poorly organized in nature and directed at the nearest available object or person. Outbursts in less severe cases, however, may appear less out of control, more organized, and more clearly directed against the source of the irritation.

In general, the aggression following temporal lobe damage involves a loss of behavioral control, is unpatterned, is not confined to particular situations, times, and individuals, and occurs with minimal provocation and no premeditation (Miller, 1990). It does not have the clear antecedents or goals that frontal lobe aggression appears to demonstrate. In many cases, frontal lobe or temporal lobe dysfunction are mistaken for one another because of a failure to note these important differences.

Episodic dyscontrol has been associated with some forms of epilepsy, a disorder characterized by sudden surges of disorganized electrical impulses in the brain. This will not usually be accompanied by gross motor problems or sudden absences, which the general public usually associates with seizures. Epilepsy is the most common chronic neuropsychological disease affecting the general population. The disorder can be associated with a clear etiology (e.g., a tumor or head trauma) or may have no discernible cause (idiopathic epilepsy.) The ictal event of a seizure is the actual seizure itself. There are additional nonictal periods representing the time before the seizure (preictal), after the seizure (postictal), and between seizures (interictal).

Episodic violence associated with epilepsy can appear during any one or more of these phases. The preictal phase is a period of minutes, hours, or even days prior to the onset of a seizure. Aggression seems to be a relatively rare occurrence during this stage. More common are nonspecific psychological changes, such as irritability, anxiety, depression, or changes in behavior (Fenwick, 1989).

Second, although extremely rare, are ictal furries (Elliott, 1987, 1988, 1992). Aggression during the ictal phase is characterized by acts that may be highly coordinated, but that occur in a confused mental state and are inappropriate to the situation (Fenwick, 1989). According to Jones (1992), the majority of ictal violence is resistive in nature rather than goal directed or purposeful. Such violent behavior

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may be the first clinical manifestation of the seizure, or it may develop as the seizure progresses.

Aggression may occur as acts that reflect *postictal automatisms* and those that are part of a postictal confusional state (Fenwick, 1989). Epileptic automatisms are regarded as a subgroup of complex partial seizures. They are often preceded by hearing things that are not there. They are generally brief and most are nonviolent (Hindler, 1989).

Violent acts occurring during a postictal confusional state are generally the result of the patient being crowded and/or physically restrained during or following a seizure (Perrine & Congett, 1994). While regaining consciousness, a patient may make clumsy movements, appear disoriented, and be very irritable (as some people are when woken from a deep sleep). If interfered with, he or she may become resentful and, while still confused, strike out (Fenwick, 1989).

Finally, a proposed link between epilepsy and violence has been hypothesized as resulting from permanent changes in personality functioning produced by seizure activity itself. This, however, has not been supported by the research to date, which indicates that such individuals are no more likely to be violent than other groups (Elliot, 1992; Jones, 1992; Mendez, Doss, & Taylor, 1993).

Jones (1992) discusses another postulated path of epileptic violence through subcortical foci or by electrical irritation from foci in deep subcortical structures. By electrical dysfunction, epilepsy produces violent or aggressive behavior of a partial complex type, but without producing the more frequently observed stereotyped behaviors identified with seizure activity. Individuals in this category are typically amnesic for the event.

While there exists a general consensus that the parts of the brain that compose the limbic system (in the deep areas of the temporal lobe) are involved in intense emotional states, debate continues regarding whether seizures predominantly involving limbic structures can be associated with directed aggression. The belief that patients with epilepsy are prone to directed violent acts during seizures has been perpetuated by the myths and the stigma surrounding the condition, as well as by the attempt of attorneys to use epilepsy as a defense in criminal cases (Perrine & Congett, 1994). However, research indicates that individuals rarely exhibit organized, directed violence due to ictal phenomena (Kaplan, Sadock, & Grebb, 1994; Lewis & Pincus, 1989; Perrine & Congett, 1994). Violence exhibited by such individuals is generally random and unconnected to specific events. However, it must be noted that seizures themselves can be set off by physical and/or psychological stress, so that the seizures are more likely in threatening and stressful situations.

### Delirium and Dementia

Delirium represents a generalized state of brain impairment that arises suddenly and most often for limited periods of time. Numerous organic causes for delirium exist, including the ingestion of substances, such as PCP, LSD, cocaine, heroin, alcohol, and similar substances, the use of legal medications in improper doses or as the

result of improper prescriptions, meningitis, encephalitis, head trauma, hypoxia, diseases of major organ systems, metabolic imbalances, and poison (Jones, 1992).

Delirium results in a confusional state that impairs the individual's judgment and perception of reality. There may be frank hallucinations and delusions, or in less-severe versions, misperceptions and misinterpretations. The individual generally shows many symptoms of a frontal lobe disorder as well: disinhibition, inability to plan or anticipate consequences, irritability, inability to integrate information, and a heightened state of emotional arousal (Jones, 1992). Delirium does not necessarily affect the person's ability to move and strike out (although coordination may be affected) or to speak or to execute plans (although these plans may not achieve their goals because of poor anticipation of consequences).

Delirious individuals may engage in aggression for a wide variety of reasons. They may believe that they are defending themselves from external threats; they may react to heightened internal emotions without any inhibitory abilities; or they may overreact to real events because of heightened irritability. Disinhibition may also allow them to perform acts that they want to perform, but would not as long as frontal inhibitory mechanisms are functional. Unlike frontal lobe injuries, delirious individuals are generally easy to identify because of a wide range of physical and psychological symptoms that are more pronounced than focal prefrontal injuries. In addition, the violence is limited to the acute times they are affected by the cause.

However, individuals with existing prefrontal problems may show symptoms of delirium more quickly than normal individuals. They appear to be much more sensitive to the effects of drugs (illegal or legal) and various medical disorders. It appears that the preexisting injuries leave them with little reserve to cope with the normal effects of a substance or condition. Thus, they are more likely to overreact to a normal illness or prescribed medication (such as some cough syrups), causing a variety of inappropriate behavior ranging from irritability to violence.

Dementia represents a loss of previous neuropsychological skills that is chronic and generally permanent. Many causes of dementia result in symptoms that develop slowly over time, although rapid onset of symptoms is possible as well. The most commonly recognized form of dementia is Alzheimer's Disease. Although there are widespread individual differences, neuropsychological problems commonly associated with Alzheimer's dementia include memory problems, visual spatial disorders, complex language, planning, inhibition, confusion, disorientation, delusions, and hallucinations (Kolb & Wishaw, 1990). Other dementing processes have similar symptoms, although the pattern and extent of deficits may vary widely with the specific cause.

Aggression in dementia arises out of several mechanisms, similar to what is seen in delirium. First, individuals may misperceive their environment and believe they are protecting themselves. Memory disorders may make people believe others are stealing from them, or cause disorientation and confusion about where they are. This can result in *flashbacks*, where individuals conclude they are in a place they were in earlier in life. If this is a negative or dangerous situation, then aggression may occur against caretakers.

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Patients may react against doctors or nurses performing medical procedures, interpreting them as attacks. Other aggression may occur only when caretakers attempt to stop them from leaving or carrying out behaviors the patients believe to be important. Some aggression may be the result of delusions, misperceptions, or hallucinations.

Many clients with dementia show symptoms that vary during the day. They generally will do better when well rested, showing a tendency to deteriorate as the day progresses. Symptoms may also increase as the result of medical illness or medication. In a descriptive survey of 14 elderly patients who attempted or committed homicide, Ticehurst, Ryan, and Hughes (1992) found that the patients showed a high level of neuropsychiatric disturbance, with dementia diagnosed in over half of the cases.

### Brain Injury in Specific Aggressive Populations

A major focus in the field has been exploring the presence of neuropsychological deficits in specific populations. This section will include reviews of the literature on marital violence, juvenile delinquency, adult criminal behavior, sex offenders, and antisocial behavior, which represent the major areas within this literature.

#### Marital Violence

In an initial study investigating the prevalence of head injury in maritally violent men, Rosenbaum and Hoge (1989) found that 19 of 31 male batterers had a history of severe head injury. Results indicated that the rate of head injury in their sample, 61.3 percent, far exceeded that found in the population at large, estimated at 5.9 percent. Rosenbaum, Hoge, Adelman, Warnken, Fletcher, and Kane (1994) found a history of head injury in 53 percent of the batterers, compared with 25 percent of a group of nonviolent, maritally discordant men, and 16 percent of a group of nonviolent, satisfactorily married men. Based on examination of the temporal order of the head injury and violence, the authors found that in 93.1 percent of the head-injured batterers, the head injury preceded the first instance of marital aggression.

Warnken, Rosenbaum, Fletcher, Hoge, and Adelman (1994) conducted a historical review of 982 male patients who had sustained either an orthopedic or head injury between 1985 and 1990. They found increased aggression and hostility in marital relationships after the head trauma compared to orthopedic injury. The female partners of the head-injured men reported significantly higher increases in verbally abusive behavior and dependency in their male partners following the injury, as well as significant decreases in communication skills and positive feelings about themselves when compared to the reports of partners of the orthopedically injured men. Changes in temperament and mood were also significant between groups, with the head-injured men and their partners reporting more depression and anger than the orthopedically injured men and partners.



## Juvenile Delinquents

Much of the literature examining neuropsychological correlates of violence and aggression have focused on juvenile males who exhibit violent behaviors. Individuals who sustain frontal lobe damage early, before developing adequate patterns of self control, are thought to be more likely to show aggressive patterns. These individuals are of concern because we would predict that individuals who are violent as a result of chronic brain injury would be more likely to continue to be violent as they grow up, and more susceptible to the effects of street drugs and alcohol, further adding to the likelihood of criminal behavior. Research has shown that juvenile delinquents with violent propensities are more likely to continue to offend as adults when compared to conduct-disordered adolescents who do not manifest violent, impulsive behavior (Dette, Kupfer, & Taub, 1975).

Researchers have looked at many possible causes for juvenile delinquency. While sociological theories contend that the violent behavior is an adaptive, learned response to adverse environmental situations, other theories suggest a neurobiological cause arising from genetic abnormalities or acquired medical problems.

Lewis and colleagues (Lewis & Shanok, 1979; Lewis, Pincus, & Feldman, 1986; Lewis, Pincus, Bard, Richardson, Pridgen, Feldman, & Yeager, 1988) found that trauma to the central nervous system (CNS) was commonly seen in violent juveniles and adults. These CNS trauma included prenatal distress, interpersonal violence, and serious accidents involving head injury.

Spellacy (1977) compared violent and nonviolent delinquent adolescent males on a comprehensive set of neuropsychological tests. Spellacy found the violent group to be impaired on 12 of 31 variables. These results indicated that the violent group, characterized by poor impulse control and consistently aggressive behavior, had more group members who manifest neuropsychological impairment than the nonviolent group. Their impaired performance was readily apparent in cognitive, perceptual, and psychomotor abilities. Interestingly, none of the organically impaired violent delinquents had been diagnosed as brain injured prior to or during their institutionalization.

## Adult Criminal Populations

The literature examining the connection between violent and aggressive behavior and neurological impairment in adult criminal offenders reaches similar conclusions to the studies using juvenile delinquent samples—violent offenders tend to have several neuropsychological indicators of brain damage, as well as decreased intellectual functioning.

Studies examining the relationship between aggression and intellectual functioning have found lower IQ scores (Sverson & Romney, 1985; Valliant, Asu, Cooper, & Mammola, 1984). The first major study to utilize a comprehensive neuropsychological battery in the assessment of violent behavior and the relationship

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to neuropsychological impairments was conducted by Bryant, Scott, Golden, and Tori (1984). Violent subjects were those who had committed assaultive crimes against persons. The control group of nonviolent inmates were convicted of property crimes.

The violent offenders were found to be significantly more impaired on all measures. When the profiles were classified for the presence or absence of brain injury, it was found that only 28 percent of the non-brain-damaged group had committed violent crimes, while 73 percent of the brain-damaged group had committed violent crimes. The violent group in this study demonstrated impaired performance on complex tasks that required integration of sensory information from the auditory, visual, and somesthetic processing systems. The violent group also lacked the ability to create, plan, organize, and execute goal-directed behavior. Sustained concentration and attention were also impaired in the violent offenders.

Langevin, Ben-Aron, Wortzman, Dickey, and Handy (1987) examined neuropsychological functioning for comparative discrimination of homicidal, violent, and nonviolent male offenders. On one neuropsychological test battery, they found that 33 percent of the murderers and 17 percent of the assaulters were significantly impaired according to Reitan's scoring criteria. None of the nonviolent sample was significantly impaired. On a second neuropsychological test battery, none of the nonviolent controls were impaired, but 21 percent of the murderers and 19 percent of the assaulters were classified as brain injured.

## Sexual Assault

Evidence of brain dysfunction is frequently found in individuals who exhibit a variety of sexual aberrations (see Cummings, 1985). Of interest here are those criminal sexual behaviors which are recognized to be the result of aggressive rather than sexual feelings.

The temporal lobes of the brain, in particular, are considered important to the expression and possible development of sexual anomalies. Kluver-Bucy Syndrome, resulting from bilateral lesions of the anterior temporal lobes, produces bizarre hypersexuality and inappropriate sexual behavior. Oppenheimer (1971) suggests that this behavior occurs when inhibitory controls are removed, similar to the dyscontrol of psychomotor seizures.

Inappropriate sexual behavior is also evident in individuals suffering from central nervous system degeneration caused by disorders such as Alzheimer's disease and Huntington's chorea. One study of Huntington's patients found inappropriate sexual behaviors in 30 of 48 patients providing sexual histories (Dewhurst, Oliver, & McNight, 1970). Disinhibition can also be a major factor in such crimes.

The poor impulse control present in sexual offenders implicates impairment in the executive functions of the frontal lobes. Sexual assaulters often describe their own behavior as impulsive and unplanned, occurring during the commission of an unrelated criminal activity, such as robbery. Research suggests that this failure to control behavior may be related to limbic system dysfunction, specifically as a fail-

ure of the cortical structures to inhibit impulses (Eysenck, 1964; Mark & Ervin, 1970). This lack of sexual impulse control may be part of the syndrome of *episodic dyscontrol* which is also marked by hyperaggressivity and pathological intoxication (Mark & Ervin, 1970).

Graber, Hartmann, Coffman, Huey, and Golden (1982) presented a series of six case histories of mentally disordered sex offenders. Three of the six subjects were found to be impaired on neuropsychological measures. These subjects tended to engage in more primitive sexual behavior and tended to lack impulse control regarding their sexual behavior. The brain damage noted was primarily localized in the temporal and frontal lobes. Decreased blood flow to the brain and decreased brain density was found in these three subjects.

Scott, Cole, McKay, Golden, and Liggett (1984) studied 36 men arrested for sexual assault. The sexual assaulters performed worse than the control group on nearly all neuropsychological measures utilized. When the sexual assaulters were separated into groups of rapists and pedophiles, the results indicated that 55 percent of the rapists and 36 percent of the pedophiles were brain damaged.

## Antisocial Personality

The psychopathic or antisocial personality can be described as being impulsive, self-centered, and aggressively opportunistic. Such individuals seem to enjoy taking unnecessary chances, appear easily bored, cannot delay prospects for immediate gratification, and evidence a low tolerance for frustration (Miller, 1987). Compared with other male criminals, individuals with antisocial personality disorder commit disproportionate numbers of crimes that are more violent and aggressive than those of other criminals (Elliot, 1992).

Yeudall (1977) presents the results of a series of studies in which individuals with forensic disorders were assessed for neuropsychological impairment. His overall findings indicate that more than 91 percent of the criminal psychopaths studied at Alberta Hospital were characterized as having dysfunction of the anterior regions of the brain.

According to Miller (1987), more impulsive and violently aggressive psychopaths tend to be less intelligent, although a causal relationship between low IQ and aggressive behavior remains to be proved. Those factors that seem to be associated with the presence of both low intelligence and aggressiveness include unsocialized personality characteristics, poor cognitive control, poor impulse control, and less anxiety and sensitivity. Subjects classified as delinquent or psychopathic who also have histories of violent or aggressive criminal acts against persons test out as less intelligent and do worse on many neuropsychological measures than do nonviolent subjects drawn from equivalent populations. In addition, there seems to be an association between frontal-lobe-like neuropsychological and behavioral manifestations and the results of similar measures obtained with adult male psychopaths.

It is necessary to recognize that what is called an antisocial personality may represent two or more subgroups. From the perspective of brain dysfunction, the

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first group represents individuals with prefrontal dysfunction (with or without other brain damage) who are impulsive, childish, unable to support themselves through normal means, and drawn into criminal behavior by their own lack of control, as well as the inducements of others. When faced with stress, they overreact and get into frequent confrontations.

The second group are criminals with intact brains, who show good planning and organizational skills. Such individuals engage in aggression for gain and as a result of planning, rather than the more impulsive aggression of the first group. These individuals are amoral, not because of brain injury, but because of environment and upbringing. These individuals may recruit others from the first group to commit crimes and aggressive acts under their direction. It is likely that this group is underrepresented in prisons compared to the first group.

## Complicating Conditions

The issue of aggression in brain-injured clients is complicated by conditions that may raise the likelihood of aggression (as well as other undesirable behaviors) in this population. One of the most important areas is the interaction between brain injury, substance abuse, and aggression (Bond, 1984; Langewin et al., 1987; Rosenbaum & Hoge, 1989; Ticehurst et al., 1992). Alcohol, a depressant, is the most commonly used and abused drug (Elliot, 1992). The main effect of alcohol intoxication is the depression of inhibitors, which predisposes even normal individuals toward aggressive behavior. Some authors note that alcohol abuse and brain damage may have a synergistic effect on the disinhibition of behavior, together predisposing, to a greater extent, individuals with developmental or acquired brain defects toward aggression (Miller, 1990; Elliot, 1992). However, separating the impact of the substance abuse from the brain injury itself is difficult.

Alcohol abuse may trigger explosive rage characterized by episodic dyscontrol (Elliot, 1992); however, the literature has found discrepant results regarding the incidence of alcohol abuse and consumption at the time of violent crime. Ticehurst and colleagues (1992) found that almost half of their elderly subjects who had attempted or committed homicide had been previous abusers of alcohol, although none reported being intoxicated at the time of the offense. Langewin and colleagues (1987) found that killers and assaulters were more often considered alcoholic, and were found to abuse alcohol with a higher frequency than nonviolent criminals. These effects may occur in individuals without brain damage, but appear more severe when the client has a preexisting brain injury.

Similar but less dramatic effects may be seen with any condition that increases the clients' fatigue or ability to concentrate. These conditions may include routine illnesses like the flu or colds, but can also include more severe medical disorders such as kidney or liver failure. Excessive fatigue due to lack of sleep or high activity levels may also increase the likelihood of aggressive responses, as can any kind of significant stressor (which in turn may be real or imagined). Clients may appear to be normal when healthy and unstressed, only to show violent behavior when stressed or fatigued.

## Summary

This review points to a strong role for neuropsychological factors in aggression and violence. As new techniques develop in neuropsychology and related areas, such as neuroradiology (e.g., Raine, Buchsbaum, & LaCasse, 1997), it is becoming increasingly evident that violent individuals—especially those who perpetrate the worst crimes and those who are repeat offenders—show substantial neuropsychological and neurological problems that must be understood and addressed if we are to deal effectively with violence in our society. An understanding of the neurobiological factors can lead to an analysis of how social and environmental policies on guns, the role of stress in modern societies, changes in medical treatments, attitudes toward violence, and childrearing practices may interact to produce violence and aggression. While our overall knowledge must be considered rudimentary in these areas, we have made substantial strides in the past two decades and are likely to see equal growth in the near future.

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