

Aggression and Violence: The Neurobiology of Experience

Dr. Bruce Perry

By [Bruce D. Perry, M.D., Ph.D.](#)

Each year in the United States alone, over 5 million children are directly exposed to violence. The most common form of destructive aggression takes place in the home in the form of physical abuse or domestic violence. The impact of these various forms of violence on children and adolescents is complex, but one result appears clear: the number of aggressive and violent youth is increasing dramatically. Young murderers (under age 18) in the United States tripled from 1984 to 1994. Currently 28,000 children and adolescents are known murderers. The number of violent crimes committed by youth is expected to double by the year 2010.

Understanding the Origins of Violence and Aggression

Are violent children conceived or created? Is there a neurobiological reason that a child is violent? What makes a child violent? Genes that make testosterone? Maternal neglect? Physical abuse? Modeling from a father hitting a mother? Impaired problem solving skills? Peer/gang pressures? Violence on television? Violent lyrics in music? Access to guns? In attempting to understand what makes a child violent, it is important to remember three points: 1) not all violence is the same; 2) the brain mediates *all* human behavior; and 3) the biological properties of the brain are the result of genotype and developmental experiences.

Violence is heterogeneous. Physical violence can be impulsive, reactive or defensive; or it can be predatory, remorseless aggression. Violent behaviors can be related to intoxication from alcohol or psychosis or other neuropsychiatric conditions (e.g., dementia, traumatic head injury). Violent acts may be the result of personal (Oklahoma City bombing) or a cultural (political terrorism) belief systems. Violence can be sexualized (rape) or directed at a specific victim (domestic violence) or at a specific group (e.g., African-Americans, homosexuals, Jews).

Aggression is not violence. An aggressive person may not be violent. Aggression is a behavior characterized by verbal or physical attack, yet it may be appropriate and self-protective or destructive and violent. The complex set of behaviors recognized as aggression has been studied in man and animals for many years. Thousands of studies have examined various aspects of the neurobiology of aggression — and the summed result is a better understanding of, simply, the neurobiology of aggressive behaviors within specific contexts, (typically animal populations in experimental conditions). Unfortunately, these insights have resulted in few advances in clinical practice or public policy related to domestic or community violence. Why? Because the complexity of violence means that there is a complexity of neurobiology. The neurobiology of aggression, studied in the lab, leads to little insight into the neurobiology of racism or misogyny — or anti-Semitism. Ironically, many violent behaviors are the result of a defensive response to perceived aggression. The neurobiology of fear, therefore, holds as many important clues to prevention and treatment interventions related to violence as the neurobiology of aggression. The neurobiology of hate — or ideology — remain unstudied — yet as surely as there are neurobiological mediators of aggression, there are neurobiological mediators of ideology.

The Brain's Role in Mediating Human Behavior

The human brain mediates all human behavior — aggression, violence, fear, ideology — indeed, all human emotional, behavioral, cognitive and social functioning. This three pound mass of 100 billion neurons and 1000 billion glial cells is infinitely complex. Yet certain principles of brain organization and function can lead to insights regarding neurological factors involved in violence and aggression.

The brain has a hierarchical organization, from the lower, more simple areas to the more complex higher cortical areas. Simple, regulatory functions (e.g., regulation of respiration, heartrate, blood pressure, body temperature) are mediated by the 'lower' parts of the brain (brainstem and midbrain) and the most complex functions (e.g., language and abstract thinking) by cortical structures.

The brain's impulse-mediating capacity is related to the ratio between the excitatory activity of the lower, more-primitive portions of the brain and the modulating activity of higher, sub-cortical and cortical areas (Cortical Modulation Ratio). Any factors which increase the activity or reactivity of the brainstem (e.g., chronic traumatic stress, testosterone, dysregulated serotonin or norepinephrine systems) or decrease the moderating capacity of the limbic or cortical areas (e.g., neglect) will increase an individual's aggressivity, impulsivity, and capacity to display violence.

As the brain develops and the sub-cortical and cortical areas organize, they begin to modulate and 'control' the more primitive and 'reactive' lower portions of the brain. With a set of sufficient motor, sensory, emotional, cognitive and social experiences during infancy and childhood, the mature brain develops — in a use-dependent fashion — a mature, humane capacity to tolerate frustration. A frustrated three year old will have a difficult time modulating the reactive, brainstem-mediated state of arousal — he will scream, kick, bite, throw and hit. However, the older child when frustrated may feel like kicking, biting and spitting, but has the capacity to modulate those urges. Loss of cortical function through any variety of pathological process (e.g., stroke, dementia, head injury, alcohol intoxication) results in *regression* — simply, a loss of cortical modulation of arousal, impulsivity, motor hyperactivity, and aggressivity — all mediated by lower portions of the central nervous system (brainstem, midbrain). Deprivation of key developmental experiences (which leads to underdevelopment of cortical, sub-cortical and limbic areas) will necessarily result in persistence of primitive, immature behavioral reactivity, and, thereby, predispose an individual to violent behavior.

The most dangerous children are created by a malignant combination of experiences. Developmental neglect and traumatic stress during childhood create violent, remorseless children. This is characterized by sensitized brainstem systems (e.g., serotonergic, noradrenergic and dopaminergic systems). Dysregulated brainstem functions (e.g., anxiety, impulsivity, poor affect regulation, motor hyperactivity) are then poorly modulated by poorly organized limbic and cortical neurophysiology and functions (e.g., empathy, problem-solving skills) which are the result of chaotic, undersocialized development. This experience-based imbalance predisposes to a host of neuropsychiatric problems and violent behavior.

As we search for solutions to the plagues of violence in our society, it will be imperative that we avoid the False God of Simple Solutions. The neurobiology of complex, heterogeneous behaviors is complex and heterogeneous. In the end, paying attention to the neurobiological impact of developmental experiences — traumatic or nurturing — will yield great insight for prevention and therapeutic interventions.

Dr. Bruce D. Perry, M.D., Ph.D., is an internationally recognized authority on brain development and children in crisis. Dr. Perry leads the ChildTrauma Academy, a pioneering center providing service, research and training in the area of child maltreatment (www.ChildTrauma.org). In addition he is the Medical Director for Provincial Programs in Children's Mental Health for Alberta, Canada. Dr. Perry served as consultant on many high-profile incidents involving traumatized children, including the Columbine High School shootings in Littleton, Colorado; the Oklahoma City Bombing; and the Branch Davidian siege. His clinical research and practice focuses on traumatized children-examining the long-term effects of trauma in children, adolescents and adults. Dr. Perry's work has been instrumental in describing how traumatic events in childhood change the biology of the brain. The author of more than 200 journal articles, book chapters, and scientific proceedings and is the recipient of a variety of professional awards.