



**INCUBATED IN TERROR:
Neurodevelopmental Factors in the 'Cycle of Violence'**

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"Children are not resilient, children are malleable."

RESILIENT

1. Marked by the ability to recover readily, as from misfortune.
2. Capable of returning to an original shape or position, as after having been compressed.

MALLEABLE

1. Capable of being shaped or formed, as by hammering or pressure: a malleable metal.
2. Easily controlled or influenced; tractable.
3. Able to adjust to changing circumstances; adaptable.

Approximately 250,000 years ago, a few thousand Homo sapiens (our first genetically-equivalent ancestors) migrated out of Africa, beginning the long transgenerational process of inhabiting and, ultimately, dominating of the rest of the natural world (Leakey, 1994). This fragile process was aided by a great deal of luck and the remarkable potential of the human brain to allow non-genetic, transgenerational transmission of information (sociocultural evolution). For thousands of generations, life was characterized by danger - - persisting threat and pervasive intra- and interspecies violence. Humankind and our current sociocultural practices evolved in -- and, therefore, reflect -- a brutal, violent and unpredictable world. The evolution of complex cultures and 'civilization' has not protected millions from the brutality which characterized the 'ascent' of humankind. While 'civilization' has decreased vulnerability to non-human predators, it has done little to decrease intraspecies violence (Keegan, 1993). Indeed, modern history is characterized by much more efficient, systematic and institutionalized violence (e.g., the Inquisition, slavery, the Holocaust, the Trail of Tears). Men were, and men remain, the major predators of vulnerable humans (typically women and children). The profound impact of domestic violence, community violence, physical and sexual abuse and other forms of predatory or impulsive violence can not be overestimated. Violence impacts the victims, the witnesses -- and, ultimately, us all. Understanding and modifying our violent nature will determine, in large part, the degree to which we will successfully 'adapt' to the challenges of the future -- the degree to which future generations of human beings can experience humanity.

In order to understand the origins and impact of interpersonal violence, it is essential to appreciate how violence alters the developing child. The child and the adult reflect the world they are raised in. And, sadly, in today's world, millions of children are raised in unpredictable and violent settings -- incubated in terror.

In the United States alone, at least 5 million children are either victims of or witnesses to physical abuse, domestic violence or community violence -- all while they are bathed in the powerful images of television which over-represent violent acts and over-value the of power violence as a solution to conflict (Perry, 1994a; Prothrow-Stith, 1991; Dodge et al., 1991; Osofsky, 1995). What is the impact of these experiences with violence on the developing child ? How does violence change the child ? What is impact of being repeatedly assaulted by a parent -- how is that different from being shot in a drive-by shooting or watching a loved one being assaulted or watching a 'pretend', but graphic, murder on television ? How do these childhood experiences contribute to the 'cycle of violence' ?

This chapter will examine these questions in context of neurodevelopment -- how these experiences influence brain development and subsequent emotional, behavioral, cognitive and social functioning of children. The amazing capacity of the human brain to develop in a 'use-dependent' fashion -- growing, organizing and functioning in response to developmental experience -- means that the major modifier of all human behavior is experience. Experience, not genetics, results in the critical neurobiological factors associated with violence. A common error in examining the 'neurobiology' of violence is to presume a neurobiological difference which may be observed in 'violent' populations

(e.g., whole blood serotonin, or CSF 5-HIAA) suggests a genetic difference. Nothing could be further from the truth.

There is no more specific 'biological' determinant than a relationship. Human beings evolved as social animals and the majority of biology of the brain is dedicated to mediating the complex interactions required to keep small, naked, weak, individual humans alive by being part of a larger biological whole -- the family, the clan. Indeed, it is the primary caretaking relationships of infancy and childhood which determine the core neurobiological organization of the human individual, thereby allowing this incredible social specialization. Experience in early life determines core neurobiology. The experiences which will be the focus of this chapter include those which predispose to violent behavior and those which result from exposure to violent behavior. It is impossible to talk about one without the other.

VIOLENCE and the DEVELOPING BRAIN

Violence is heterogeneous -- in etiology, quality, quantity and impact on its victims. Physical violence can be the result of impulsive, reactive behavior or predatory, remorseless aggression. Physical violence can be related to intoxication from alcohol or from psychosis or from other neuropsychiatric conditions (e.g., dementia, traumatic head injury) . Physical violence may be the result of personal (Oklahoma City bombing) or a cultural (political terrorism) belief system. Physical violence can be sexualized (rape) or directed at a specific victim (domestic violence) or at a specific group (e.g., African-Americans, homosexuals, Jews). Violence may be physical or emotional. Indeed, some of the most destructive violence does not break bones, it breaks minds (Vachss, 1994). Emotional violence does not result in the death of the body, it results in death of the soul.

The major setting for violence in America is the home (Straus, 1974). Intrafamilial abuse, neglect and domestic battery account for the majority of physical and emotional violence suffered by children in this country. Despite this, a majority of our entertainment, media and public policy efforts focus on community or predatory violence. Understanding the roots of community and predatory violence will be impossible without examining the effects of intrafamilial violence, abuse and neglect on the development of the child. Indeed the adolescents and adults responsible for community and predatory violence likely developed their emotional, behavioral, cognitive and physiological characteristics mediating these violent behaviors as a result of intrafamilial violence during childhood.

What are the pathways from a terrorized child to a terrorizing adolescent ? How can someone develop the capacity to stalk, torture, murder and mutilate another human being and feel no remorse -- even feel pleasure ? How can a 14 year old kill someone over a jacket ? How can someone load a truck with explosives and blow up a building full of anonymous and innocent people ? How can someone beat senseless the woman they 'love' and, if she leaves, taking the children, track them down and kill them all ? Why are

men so much more violent than women ? What happens to people to make them act like "animals" ?

All violent behavior impacts the children in its wake. There is heterogeneity of impact, however. Important factors in the differential impact on the developing child include the type of violence, the pattern of violence, the presence (or absence) of supportive adult caretakers and other support systems, and, of key importance, the age of the child. Under all circumstances, however, the organ which allows the child victim to adapt to a violent trauma is the brain -- just as the brain is the organ that is the origin for the violent behaviors of the victimizer. How is it that the very neurobiological adaptations which allow the child to survive violence may, as the child grows older, result in an increased tendency to be violent ? It is not the finger pulling the trigger that kills; it is not the penis that rapes -- it is the brain. In order to understand violence we need to understand the organization and functioning of the brain.

Brain Organization and Function

The human brain is an amazing organ which acts to sense, process, perceive, store and act on information from outside and inside the body to promote survival. In order to carry out these functions, the human brain has evolved a highly functional hierarchical organization -- from the lower, more simple portions to the more complex higher cortical regions (Figure 1). Various functions are mediated by various brain areas -- with more simple, regulatory functions (e.g., regulation of respiration, heartrate, blood pressure, body temperature) mediated by the 'lower' parts of the brain (brainstem and midbrain) and the most complex functions (e.g., language and abstract thinking) mediated by the most complex cortical structures of the human brain. A hierarchy of increasingly complex functions is mediated by the hierarchy of increasingly complex brain areas (Figure 1).

The structural organization and functional capabilities of the mature brain develop throughout life, with the vast majority of the critical structural organization taking place in childhood. Brain development is characterized by 1) sequential development and 'sensitivity' -- from the brainstem to the cortex -- and 2) 'use-dependent' organization of these various brain areas. Essential to understanding the neurobiology of violence is that 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 (Figure 3). Any factors which increase the activity or reactivity of the brainstem (e.g., chronic traumatic stress) or decrease the moderating capacity of the limbic or cortical areas (e.g., neglect, EtOH) will increase an individual's aggressivity, impulsivity and capacity to be violent (see below). A key neurodevelopmental factor which plays a major role in determining this moderating capacity is the brain's amazing capacity to organize and change in a 'use-dependent' fashion.

The brain organizes in a use-dependent fashion. In the developing brain, undifferentiated neural systems are critically dependent upon sets of environmental and micro-environmental cues (e.g., neurotransmitters, cellular adhesion molecules, neurohormones, amino acids, ions) in order for them to appropriately organize from their undifferentiated, immature forms (Perry, 1994a; Perry et al., 1994b; Lauder, 1988). Lack, or disruption, of these critical cues can result in abnormal neuronal division, migration, differentiation, synaptogenesis -- all of which contribute to malorganization and diminished functional capabilities related to that portion of the brain (Perry, 1988; Perry, 1994a; Perry, 1995a). These molecular cues, in turn, are dependent upon the experiences of the developing child. The quantity, pattern of activity and nature of these neurochemical and neurotrophic factors depends upon the presence and the nature of the total sensory experience of the child (Carlson et al., 1989; Kandel, 1989; Goelet et al., 1986).

Different areas of the CNS are organizing at different times and, therefore, either require (critical periods) or are most sensitive (sensitive periods) to organizing experiences (and the neurotrophic cues related to these experiences). Disruptions of experience-dependent neurochemical signals during these periods may lead to major abnormalities or deficits in neurodevelopment -- some of which may not be reversible (see below). Disruption of critical cues can result from 1) lack of sensory experience during critical periods or 2) atypical or abnormal patterns of necessary cues due to extremes of experience. Due to the sequential development of the brain, disruptions of normal developmental processes early in life (e.g., during the perinatal period) which alter development of the brainstem or midbrain will necessarily alter the development of limbic and cortical areas because critical signals these areas depend on for normal organization originate in these lower brain areas (see Figure 4). The clear implication of this neurophysiological chain of development is that, again, early life experiences have much more relative importance in organizing the mature brain. Experiences which could be tolerated by a 12 year old child can literally destroy an infant (e.g., being untouched for two weeks). Both lack of critical nurturing experience and excess exposure to traumatic violence will alter the developing CNS, predisposing to a more impulsive, reactive and violent individual.

Emotional Neglect

A fifteen year old boy sees some shoes he wants. Another child is wearing them -- so he pulls out his gun and demands the shoes. The younger child, at gunpoint, takes off his shoes and gives them up. The fifteen year old puts the gun to the child's head, smiles and pulls the trigger. When he was arrested, the officers are chilled by the apparent lack of remorse. Asked later whether he could turn back the clock and do anything differently, he thinks and replies, "I would have cleaned my shoes." His bloody shoes led to his arrest. He exhibits regret for being caught, an intellectual, cognitive response, -- but not remorse, an affect. He feels no connection to the pain. He was neglected and humiliated by his primary caretakers when he was young. This fifteen year old murderer literally has emotional retardation. The part of his brain which would have allowed him to feel connected to other human beings and feel something did not develop, literally. He has

affective blindness. Just as the retarded child has no capacity to ever understand abstract cognitive concepts, this young murderer has no capacity to be connected to other human beings in a healthy way. Experience, or rather lack of critical experiences, resulted in this affective blindness -- this emotional retardation.

Very narrow windows - critical periods - exist during which specific sensory experience is required for optimal organization and development of any brain area -- and function. While critical periods have been examined in great detail in non-human animals for the primary sensory modalities, similar use-dependent differentiation in development of the brain occurs for the rest of the central nervous system (Diamond et al., 1964; Altman et al., 1964; Cragg, 1967; Cragg, 1969; Cummins et al., 1979). Abnormal micro-environmental cues and atypical patterns of neural activity during critical and sensitive periods can result in malorganization and compromised function in other brain-mediated functions such as empathy, attachment and affect regulation (Green et al., 1981). Some of the most powerful clinical examples of this are related to lack of 'attachment' experiences early in life. The child who has been emotionally neglected early in life will exhibit attachment problems which are extremely insensitive to any 'replacement' experiences including therapy (Carlson et al., 1989; Ebinger, 1974). Examples of this include feral children, Spitz's orphans (Spitz et al., 1946), the Romanian orphans and, sadly, the remorseless, violent child.

Lack of appropriate affective experience early in life and the resulting malorganization of attachment capabilities plays a major role in the current epidemic of senseless violence in the United States today. So often, these acts are inhuman -- throwing a little boy out of a window because he didn't steal candy, -- planning, stalking, kidnapping and torturing someone who 'disrespected' you -- hunting any homeless man to start on fire. Senseless -- or are they senseless acts? The ability to feel remorse, to be empathetic, to be sympathetic -- are all experience-based capabilities. If a child feels no more emotional attachment to another human being than to any other animal, then one cannot expect any more remorse from them after killing a human than one would expect from someone who ran over a squirrel. These behaviors are not senseless, they are not beyond our understanding. They arise from children reflecting the world they were raised in (Taylor et al., 1992; Perry, Pollard, Blakley, Baker, & Vigilante, in press).

It is important to clarify that the majority of individuals who are emotionally neglected in childhood do not end up violent. These individuals carry their scars in other ways, usually in a profound emptiness, or in emotionally destructive relationships, moving through life disconnected from others and robbed of some of their humanity. The effects of emotional neglect in childhood predispose to violence by decreasing the strength of the sub-cortical and cortical impulse-modulating capacity and by decreasing the value of other humans due to an incapacity to empathize or sympathize with them. This decreased value of humans means that there is a much lower threshold for the unattached person to act in an antisocial fashion to gratify their impulses.

Cognitive Neglect

There are other deprivations of experience which play a major role in impulsive and reactive violence. These are experiences which, in effect, 'feed' and grow the human cortex. As the cortex plays a major role in inhibiting, modulating and regulating the functioning of the lower parts of the central nervous system, any experiences which increase this cortical capacity would be expected to decrease violent behavior. The human cortex grows in size, develops complexity, makes synaptic connections and modifies as a function of the quality and quantity of sensory experience. Lack of type and quantity of sensory-motor and cognitive experiences leads to underdevelopment of the cortex (see Figure 5). The cortical and sub-cortical areas are smaller in individuals who have global environmental neglect. In our preliminary studies, we have demonstrated 'cortical atrophy' (as read independently by neuroradiologists) in 7 of 12 severely neglected children (Pollard and Perry, submitted). These children (average age 8) did not develop cortical and subcortical structures and then have them atrophy. These areas, which develop in a use-dependent fashion, were under-used, resulting in profound underdevelopment of these areas. There are multiple examples the negative impact of environmental deprivation on the developing brain from the animal studies. Rats raised in environmentally enriched setting have a 30% higher synaptic density in cortex than rats raised in an environmentally deprived setting (Bennett et al., 1964; Altman et al., 1964). Animals raised in the wild have from 15 to 30% larger brain mass than their offspring who are domestically reared (Darwin, 1868; Rehkamper et al., 1988; Rohrs, 1955).

An striking example of the role of cognitive development (development of a literate population) on violence comes from historical accounts of violence. In the year 1340 in Amsterdam, the murder rate was in excess of 150 murders per 100,000 people. Two hundred years later the murder rate was below 5 per 100,000 people. Clearly this is not a 'genetic' phenomenon. The genetics of the population of Amsterdam likely did not change much in two hundred years. This marked decrease in the incidence of the murderous violence likely is due to the development of a higher percentage of individuals in that society having better developed cortices -- more capable of abstract cognition, more capable of modulation of aggressive and violent impulses. The sociocultural phenomenon underlying the development of healthier, more capable cortices was literacy. The introduction of the printing press allowed the percentage of literate (i.e., cortically-enriched, cognitively-capable individuals) to dramatically increase. Over a few generations, the impact of a number of bright, abstract individuals transformed their society.

The introduction of television has had a similar revolutionary impact on the organization and functional capacity of the human brain (remember, the organization and functional capacity of the brain reflects the pattern and nature of sensory input during development). The implications of this major sociocultural and environmental phenomenon on development has yet to be fully realized. Ominous clues abound, however. American children raised on Sesame Street and MTV are impatient with even moderately slow presentations of any stimuli, written, spoken, visual. The brain of a human infant born in 20,000 B.C. had the same potential as an infant born in 1995. Despite the fact that 20,000

years ago there was essentially little language, no science, no understanding of 'computers', if this pre-historic infant was raised today, she would be playing Nintendo, watching MTV, reading, writing and 'thinking' in as abstract a fashion as any child born today. The brains of our children are organized differently from ours. The increase in youth violence is related to the world we have provided for our children to grow up in (Wright et al., 1992; Taylor et al., 1992; Richters, 1993; Osofsky, 1995) -- a world different from the one in which we grew up in.

Traumatic Violence: The Persisting State of Fear

Children exposed to violence are more likely to be violent. This is related to many factors, including modeling and learning that violent aggression is acceptable, even a preferable and honorable, solution to problems. Yet analysis of much of the violent behavior by children and adolescents today reveals a troubling degree of impulsive, reactive violence. This violence is often interpreted by the perpetrators as defensive. "If I didn't shoot him, he would have shot me." "I could tell that he was going to jump me -- he looked me in the eyes." "Listen, man, I did him before he did me. So." These verbalizations reflect the persistence of a state of fear, literally, a persisting 'fight or flight' state which these adolescents are unable to get out of. The persistence of this originally adaptive internal state is due to growing up in a persistently threatening environment.

If during development, this stress response apparatus are required to be persistently active, the stress response apparatus in the central nervous system will develop in response to constant threat. These stress-response neural systems (and all functions they mediate) will be overactive and hypersensitive. It is highly adaptive for an child growing up in a violent, chaotic environment to be hypersensitive to external stimuli, to be hypervigilant, and to be in a persistent stress-response state (see Figure 6).

Clinically, this is very easily seen in children who are exposed to chronic neurodevelopmental trauma (Perry, 1994a; Perry, 1995a). These children are frequently diagnosed as having attention deficit disorder (ADD-H) with hyperactivity (Haddad et al., 1992). This is somewhat misleading, however. These children are hypervigilant, they do not have a core abnormality of their capacity to attend to a given task. These children have behavioral impulsivity, and cognitive distortions all of which result from a use-dependent organization of the brain (Pynoos et al., 1985; Pynoos, 1990). During development, these children spent so much time in a low-level state of fear (mediated by brainstem and midbrain areas) that they consistently were focusing on non-verbal but not verbal cues. In our clinical population, children raised in chronically traumatic environments a prominent V-P split on IQ testing (n = 108; WISC Verbal = 8. 2; WISC Performance = 10.4, Perry et al., in preparation). This is consistent with the clinical observations of teachers that these children are really smart but can't learn easily. Often these children are labeled as learning disabled. These difficulties with cognitive organization contribute to a more primitive, less mature style of problem-solving -- including violence.

These children are also characterized by persisting physiological hyperarousal and hyperactivity (Perry, 1995a; Perry, Pollard, Blakley, Baker, & Vigilante, in press). These children are observed to have increased muscle tone, frequently a low grade increase in temperature, an increased startle response, profound sleep disturbances, affect regulation problems and anxiety (Kaufman, 1991; Ornitz et al., 1989; Perry, 1994a). In addition, our studies indicate that a significant portion of these children have abnormalities in cardiovascular regulation (Perry, 1994a; Perry et al., 1995b). All of these symptoms are the result of a use-dependent organization of the brain stem nuclei involved in the stress response apparatus (Perry, 1988; Perry et al., 1994b).

The implications of this for the violent youth are apparent. First, any child exposed to chronic intrafamilial violence will develop a persisting fear response. Because there are marked gender differences in this response (Perry et al., 1995b; Perry, Pollard, Blakley, Baker, & Vigilante, in press), with females more likely to dissociate and males more likely to have a classic fight or flight response, more males will develop the aggressive, impulsive, reactive and hyperactive symptom presentation. Males will more likely be violent (George et al., 1979). This can be explained, in part, by the persistence of this fight or flight state -- and by the profound cognitive distortions that accompany this neurodevelopmental state. A young man with these characteristics, then, will very easily misinterpret a behavior by someone as threatening and will, being more reactive, act in more impulsive and violent fashion. Literally, using the original adaptive 'fight or flight' response in a new context but this time in a maladaptive fashion.

Finally, this reactivity of response is profoundly exaggerated when the individual is under the influence of alcohol or other drugs. Unfortunately, the emotional emptiness resulting from neglect can only be filled by the temporary pleasure that an exogenous euphoriant (e.g., heroin, cocaine) can provide. Similarly, a young man may find the only escape from the distress and pain caused by the anxiety of a persisting fear response is with alcohol. It is often the intoxicating agents that allow expression of the neurodevelopmentally-determined pre-disposition for violence (Figure 8).

Ideology of Aggression

There are multiple pathways to engaging in violent behavior. Some are defensive, some are predatory, some are impulsive. All of these pathways, however, are facilitated by belief system. The majority of neglected children never become violent. The majority of traumatized children never become violent. Even the majority of traumatized and neglected children do not become remorselessly violent. Belief systems, in the final analysis, are the major contributors to violence. Racism, sexism, misogyny, children as property, idealism of violent heroes, cultural tolerance of child maltreatment, nationalism -- all unleash, facilitate, encourage, and grow violent individuals. Without these facilitating belief systems and modeling, the neglected and abused child would carry their pain forward in less violent ways.

Extreme violence of the most heinous sort (organized, systematic and remorseless) is conducted by individuals, groups of individuals, and by governments with the blessing of belief systems (for God and Country). Indeed, the current "Violence Prevention" initiatives are really not interested in preventing all violence. These programs are focused on random, unpredictable physical violence against 'us'. The pervasive community violence of the inner cities was of little concern to the public policy makers in government until it spread to other parts of our society. Widespread ignorance of the intimate relationships between cultural belief systems, childrearing practices and the development of violent behaviors will doom any attempts to truly understand and prevent violence (Dodge et al., 1991; Richters, 1993).

Malignant Combination of Experiences

The most dangerous among us have come to be this way because of a malignant combination of experiences. Lack of critical early life nurturing, chaotic and cognitively impoverished environments, persisting fear and physical threat and, finally, watching the strongest, most violent in the home get what he wants, and seeing the same aggressive violent use of power idealized on television and at the movies (Figure 9). These violent offenders have been incubated in terror, waiting to be old enough to get "one of those guns", waiting to be the one who controls, the one who takes, the one who hits, the one who can "make the fear, not take the fear." Unfortunately, because of clear socio-cultural devolution in some segments of our communities, there are more and more undersocialized, traumatized children. These children get little cognitive stimulation -- the public schools are falling apart; getting little emotional contact -- mom is a child herself and pregnant again; getting little predictability, structure or nurturing out of the home -- the community has dissolved.

Clinical Implications

There are a variety of important clinical considerations when looking at the interplay between developmental trauma and brain development. One of the most obvious is the time of development when the trauma takes place. The same event which occurs at age 15 may be much more traumatic at an early age. The younger someone is the fewer defensive capabilities they have. As we get older, reasoning and cognitive capabilities facilitate adaptation.

The intensity and frequency of the trauma determines how, in a use-dependent fashion, the brain will internalize the traumatic event. The proximity to threat, the degree to which body integrity and life-threatening experiences take place and the presence of protective factors play some role in this. The presence of a strong supportive family network or a strong stable adult figure is critically important. Children exposed to violence benefit from the presence of a stable adult.

The degree to which threat is perceived to be predictable is important in determining how traumatic the stress is. Stress is much more tolerable when it is relatively predictable. Indeed, there are a number of behavioral features of traumatized children which initially appear to be very maladaptive but are in fact very highly adaptive. This is seen with behaviors which solicit or promote either physical or sexual abuse. A child who has been a victim of unpredictable sexual or physical abuse learns (conscious or unconscious) that if this abuse is going to happen, it is far preferable to control when it happens. As a result, children who have been violently physically assaulted will frequently engage in provocative, aggressive behavior in an attempt to elicit a predictable response from the 'environment'. This behavior is often misinterpreted and the school or foster placement will punish them severely (often following a restraint situation) and re-inforce the child's view of the world -- adults are aggressive and solve problems using force. Our ineffective child protective, mental health and juvenile justice systems teach this lesson to children again and again -- until they are big enough, smart enough or violent enough to turn the tables.

Intervention strategies with the emotionally-empty violent youth must be different from that for a purely impulsive, reactive violent youth. Heterogeneity of violence dictates heterogeneity of intervention. Effective implementation of intervention and prevention strategies, therefore, requires effective assessment of the emotional, behavioral, cognitive, social and physiological functioning of the individual child (Vachss et al., 1979). A 'boot camp' model may be very effective for some, and dreadfully ineffective for others. Therapeutic intervention based upon interpersonal relationships may be critical for rehabilitation of some, while they are a waste of resources for others.

State-dependent storage and state-dependent recall are critical issues to consider when focusing on the violent youth. When a child is in a state of hyperarousal -- a persisting fear-state -- this child will not easily be taught complex cognitive information, i.e., if the cortex is not active, it will not store information. The child will be focusing on non-verbal cues -- body movements, facial expressions, tone of voice -- searching for threat- storing that information, not the words which may accompany this. Only when significantly 'calmed' will these children benefit from 'words'. What we can expect a child to have access to during these states of arousal is their 'catalogue' of previous experiences -- their non-verbal memories, many of which are characterized by unpredictability, threat, pain, assault. They will act accordingly. It is the task of therapeutic interventions to begin to provide a set of alternative memories based upon trial after trial of neutral or positive interaction. Unfortunately, our interventions frequently mistarget the needs of a given child.

Interventions which are based simply upon a cognitive, problem-solving approach to conflict resolution can not be easily generalized to the threatening situation. When a child or adolescent sits quietly in a room with peers and can think through a situation, non-violent resolution comes easily. This same child, however, when threatened will be in a different internal state. The fearful child's cognition and behavior is being mediated by more primitive parts of the brain -- she will be more reactive, reflexive and will have a very difficult time pulling cognitive solutions from her cortex. Experience-based conflict

resolution models offer advantages over simple cognitive, classroom based programs. Imagine a soldier trying to effectively learn how to act in combat by sitting in class. The soldier could learn, on a cognitive level, what to do. In combat, however, finding and applying this 'book-learning' will be impossible.

Public Policy Implications

Ultimate solution to the problems of violence -- whether from the remorseless predator or the reactive, impulsive youth -- is primary prevention. Our society is creating violent children and youth at a rate far faster than we could ever treat, rehabilitate or even lock away (Groves et al., 1993; Garbarino, 1993; Sturrock et al., 1983; Richters, 1993). No single intervention strategy will solve these heterogeneous problems. No set of intervention strategies will solve these transgenerational problems. In order to solve the problems of violence, we need to transform our culture.

We need to change our childrearing practices, we need to change the malignant and destructive view that children are the property of their biological parents. Human beings evolved not as individuals, but as communities. Despite Western conceptualizations, the smallest functional biological unit of humankind is not the individual. It is the clan. No individual, no single parent-child dyad, no nuclear family could survive alone. We survived and evolved as clans -- interdependent -- socially, emotionally and biologically. Children belong to the community, they are entrusted to parents. American society, and its communities, have let down parents and children. We have not provided parents with the information and resources to optimize their children's potential and, when parents fail, we act too late and with impotence to protect and care for maltreated children.

The true potential of the human brain is rarely, if ever, realized. The major expressor of that potential is experience. The most critical and formative experiences are those provided to the developing child in the incubator of the family and, optimally, by a vital, invested community. Past and present, our society dramatically undervalues children, despite the claims that 'we love children'.

It is in the nature of humankind to be violent, but it may not be the nature of humankind. Without major transformation of our culture, without putting action behind our 'love' of children, we may never find out.

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FIGURES

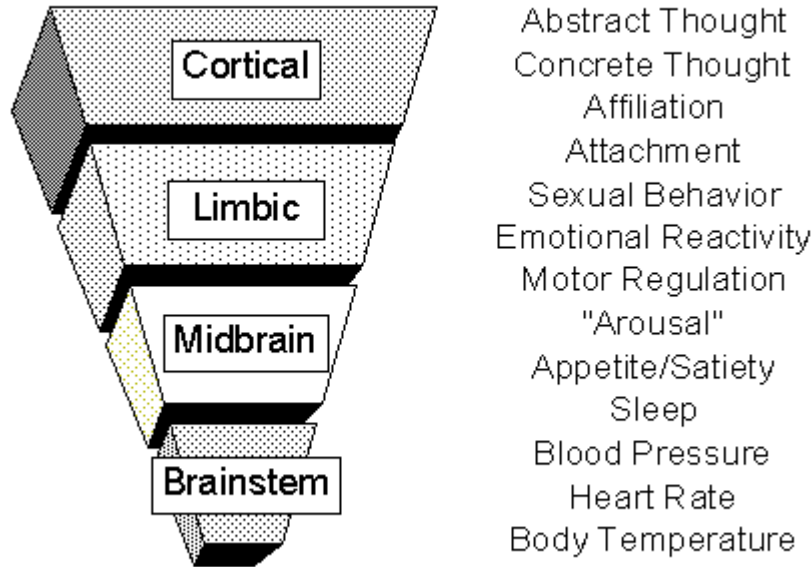


FIGURE 1. Hierarchy of Brain Function. The human brain is organized from the most simple (e.g., fewest cells: brainstem) to most complex (e.g., most cells and most synapses: frontal cortex). The various functions of the brain, from most simple and reflexive (e.g., regulation of body temperature) to most complex (e.g., abstract thought) are mediated in parallel with these various areas. These areas organize during

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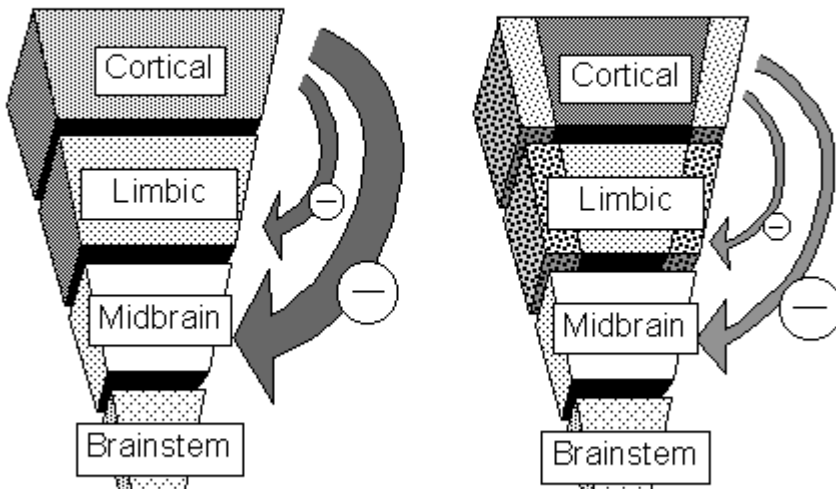


FIGURE 2: Cortical Modulation: The capacity to moderate frustration, impulsivity, aggression and violent behavior is age-related. With a set of sufficient motor, sensory, emotional, cognitive and social experiences during infancy and childhood, the mature brain develops - in a use-dependent fashion -- a mature, humane capacity to tolerate frustration, contain impulsivity and channel aggressive urges.

Optimal Developmental Experience

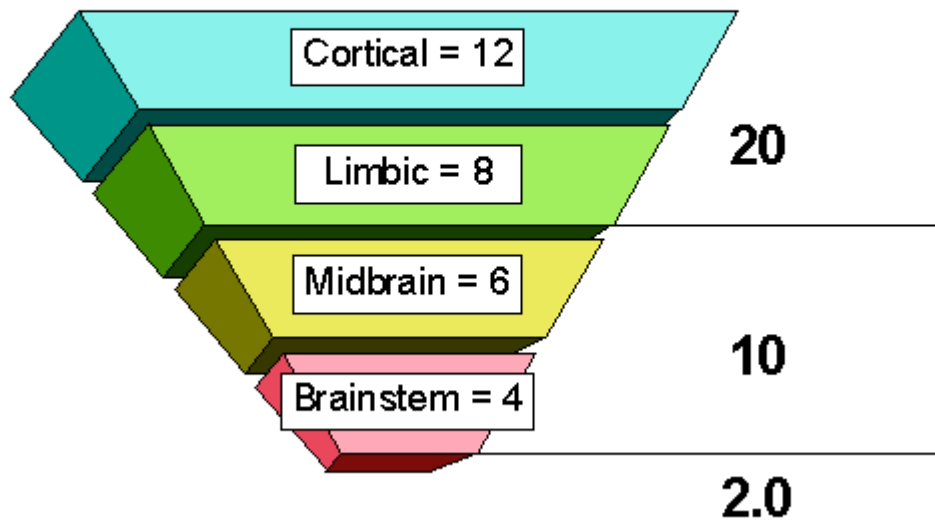


FIGURE 3. Ratio of Modulation: Optimal Development. A healthy Cortical Modulation ratio (Cortical and Limbic/Midbrain and Brainstem) develops when the child experiences a variety of optimal emotional, behavioral, cognitive and social experiences at key times during their development. This ratio indicates the relative 'power' of the maturing and mature brain to modulate the more primitive, reactive, reflexive output of the brainstem and midbrain. During infancy and childhood, sequential development of the brain necessitates that the lower, more primitive portions of the brain develop first and, over time, the output of these areas is shaped, modulated, modified in more mature fashion as the higher brain areas develop. Any disruption of development which either 'overdevelops' the midbrain and brainstem or 'under-develops' the limbic and cortical areas will result in an imbalance in the Cortical Modulation ratio, predisposing to aggressive and violent behavior.

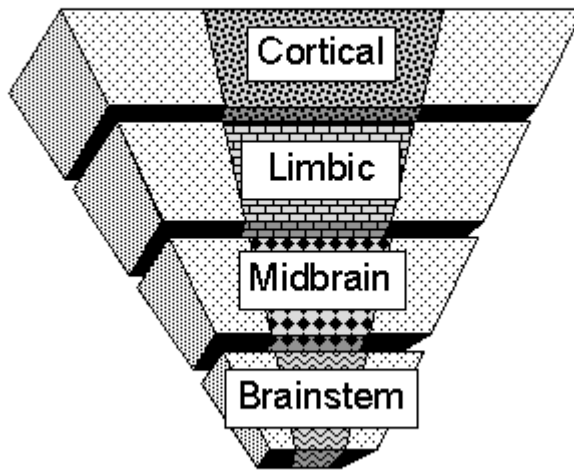


FIGURE 4. Sequential Development of the Brain. The simple and unavoidable result of this sequential neurodevelopment is that the organizing, 'sensitive' brain of an infant or young children is more malleable to experience than a mature brain. While experience may alter and change the functioning of an adult, experience literally provides the organizing framework for an infant and child. The brain is most plastic (receptive to environmental input) in early childhood, therefore, the child is more vulnerable to variance of experience during this time.

Developmental Neglect

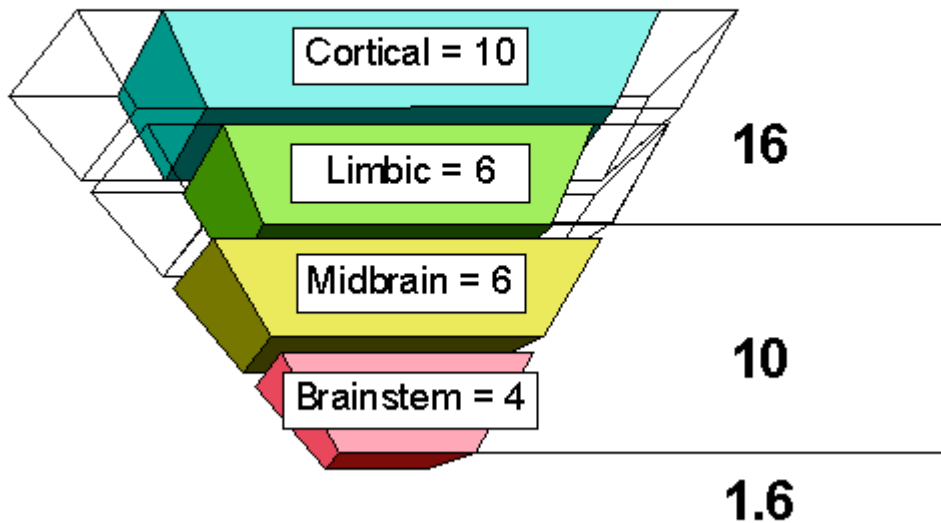


FIGURE 5. Developmental Neglect: Emotional or Experiential Deprivation. The ability of the brain to develop a healthy Cortical Modulation ratio (Cortical and Limbic/Midbrain and Brainstem) is impaired when key experiences are minimal or absent. This results in poor modulation of impulsivity, persisting 'primitive' or immature emotional and behavioral functioning and, in combination with other developmental experiences, a predisposition to violence. The ability of the maturing brain then, to modify impulsive and reactive responses in the face of stress or frustration is decreased in individuals deprived of specific developmental experiences.

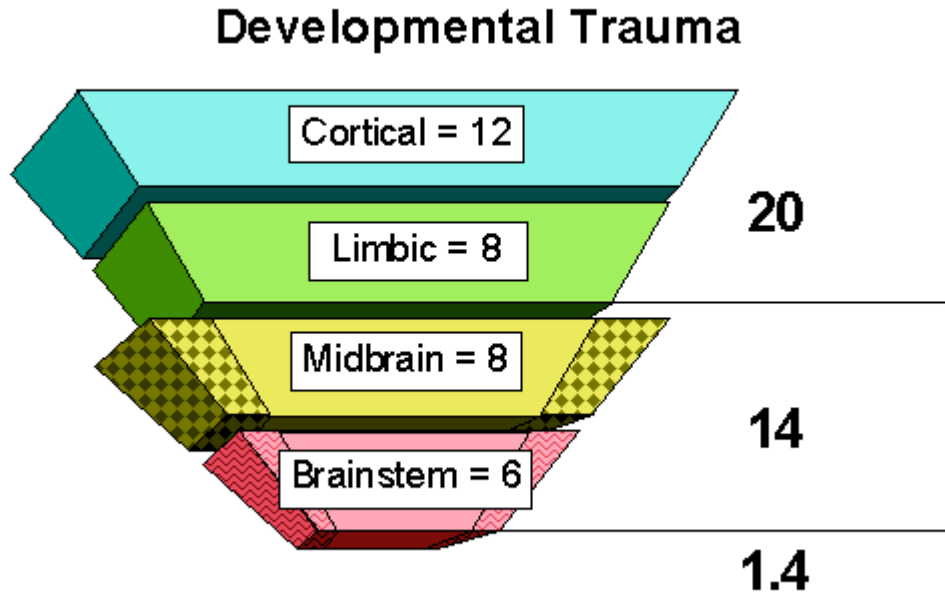


FIGURE 6. The Persisting Fear Response: Developmental Trauma. A child raised in an environment characterized by persisting trauma (e.g., domestic violence, physical abuse, community violence) will develop an excessively active and reactive stress-response apparatus. The majority of the stress response systems reside in the brainstem and midbrain (e.g., locus coeruleus). Overdevelopment of these areas, even in the presence of optimal emotional or cognitive experience will result in an altered Cortical Modulation ratio and, a predisposition to act in an aggressive, impulsive, behaviorally reactive fashion.

Neglect and Trauma

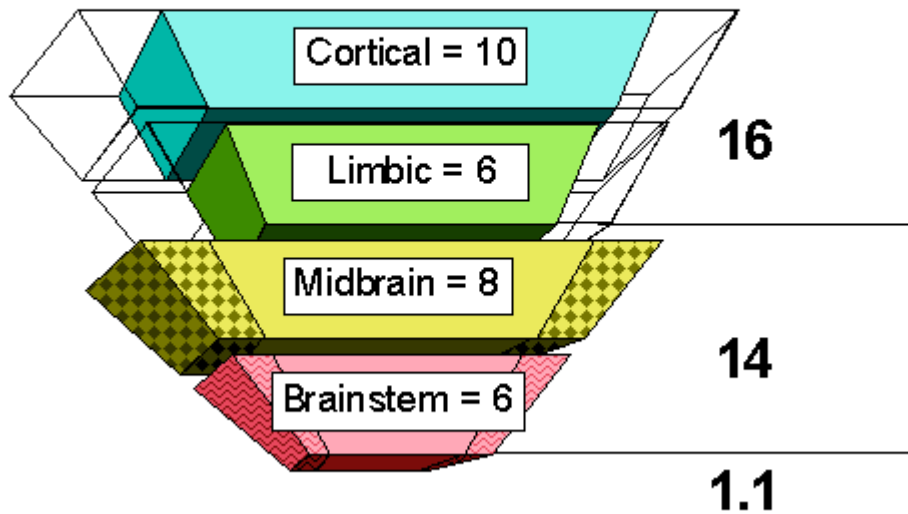
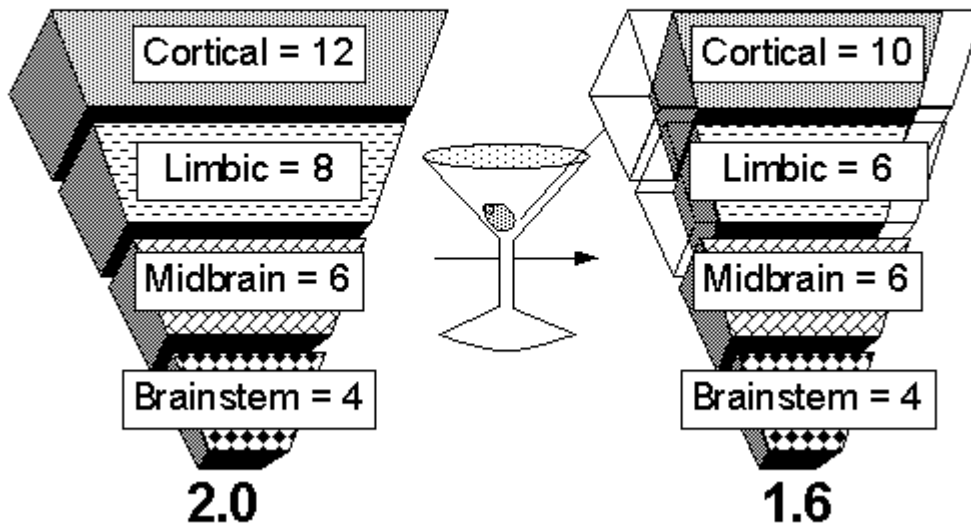


FIGURE 7. Neglect and Trauma: The Malignant Combination. Developmental neglect or traumatic stress during childhood can profoundly alter development. Unfortunately, emotional and cognitive neglect usually occur in combination with traumatic stress. The combination of a lack of critical emotional experiences and persisting traumatic stress leads to a dramatic alteration in the brain's modulation and regulation capacity. This is characterized by an overdevelopment of brainstem and midbrain neurophysiology and functions (e.g., anxiety, impulsivity, poor affect regulation, motor hyperactivity) and an underdevelopment of limbic and cortical neurophysiology and functions (e.g., empathy, problem solving skills). This experience-based imbalance predisposes to a host of neuropsychiatric problems -- and, violent behavior.

Effects of EtOH *Optimal Brain*



Effects of EtOH *Neglect and Trauma Brain*

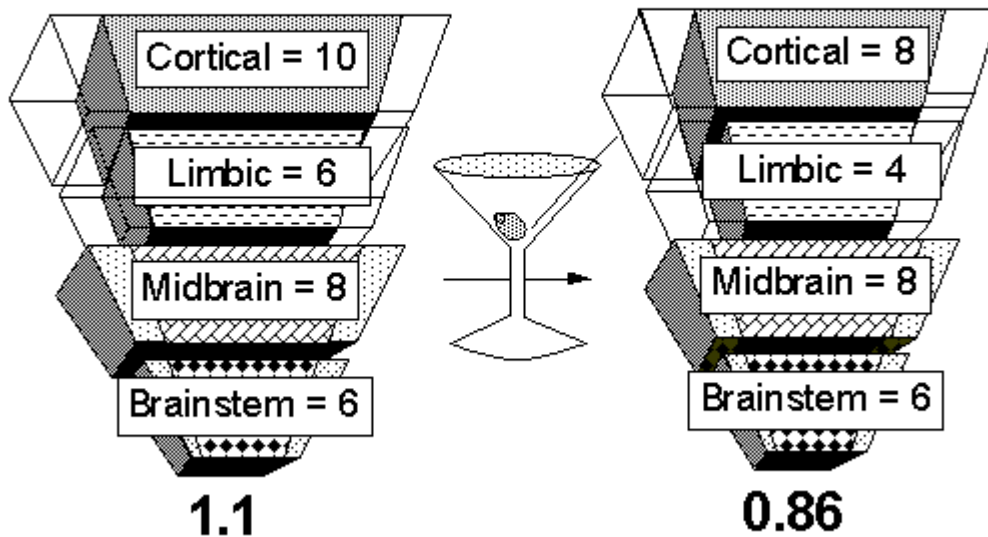


FIGURE 8. Alcohol Decreases the Cortical Modulation Ratio. Upper Panel. Alcohol has a well-documented relationship with violent behavior. Under optimal circumstances, drinking can decrease judgment, impair capacity to modulate impulsivity and predispose to aggressive and violent behaviors. Alcohol does this, in part, because of mass action

effects of the non-specific actions on neurons, decreasing functional capacity in all cells. Because the cortex has the most cells, however, it is relatively more-sensitive to the non-specific effects of alcohol, resulting in the general phenomenon of 'getting' drunk from the top down. The sequence of loss of function under the influence of alcohol match the hierarchical sequence as illustrated in Fig. 1. The temporary decrease of Cortical Modulation ratio under the influence of alcohol leads to many violent actions.

Lower Panel: The capacity of alcohol to impair functioning and decrease Cortical Modulation ratio is even more dramatic in the poorly organized brain. The combination of alcohol (or other drugs) and a neglected, abused adolescent often leads to deadly and chilling violence.

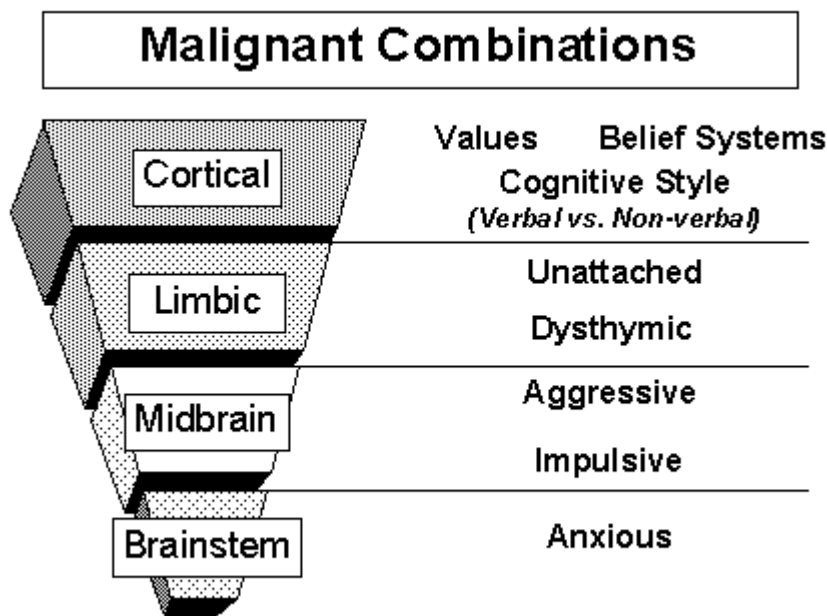


Figure 9. Malignant Combination of Experience: Neurodevelopmental experiences of trauma or neglect alter a variety of brain areas and functions important in predisposing to violence. Depending upon the time in development, the nature and extent of the abuse and the presence of attenuating factors, the developing brain will be impacted differentially. These experiences may occur in utero or in the perinatal period, impacting the brainstem and resulting in symptoms of anxiety. Experiences in the perinatal and first few years of life can impact the midbrain resulting in impulsive and aggressive symptoms. Trauma and neglect during infancy and childhood can impact the sub-cortical and limbic areas, resulting in dysthymic, depressed or unattached individuals. Finally, experiences throughout childhood can impact the development of cognitive capabilities resulting in processing and problems solving styles which predispose to violent solutions. Ultimately, however, being anxious or impulsive or depressed or unattached or cognitively impaired do not alone lead to violence. It is a malignant combination of one

or more of these vulnerabilities in concert with a facilitating or encouraging belief system that leads to violent behaviors.