

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 -- omnipresent 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' have not protected millions from the brutality which characterized the 'ascent' of humankind. While 'civilization' has decreased our vulnerability to non-human predators, it has done little to decrease intraspecies violence (Keegan, 1993). Indeed, modern history is characterized by increasingly 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 assault 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 actually 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 unstable and violent settings. Literally, incubated in terror.

In the United States alone, at least 5 million children are victims of and/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 viability of violence as a solution to conflict (Perry, 1994a; Prothrow-Stith, 1991; Dodge et al., 1991; Osofsky, 1995). What is the impact of these pervasive experiences with violence on the developing child? How does violence change the child? What is the impact of being repeatedly assaulted by a parent -- how is that different from being targeted 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 much-discussed but little-understood '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 trait, a biochemical marker (e.g., whole blood serotonin, or CSF 5-HIAA), which may be altered in 'violent' populations 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. Early life experience 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. The two are inextricably intertwined.

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 a 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 (see Koop et al., 1992; Horowitz et al., 1995; Carnegie Council on Adolescent Development, 1995). 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 is impossible unless the effects of intrafamilial violence, abuse and neglect on the development of the child are examined. Indeed, the adolescents and adults responsible for community and predatory violence likely developed the emotional, behavioral, cognitive and physiological characteristics which mediate these violent behaviors as a result of intrafamilial violence during childhood (O'Keefe, 1995; Myers et al., 1995; Mones, 1991; Hickey, 1991; Loeber et al., 1993; Lewis et al., 1989).

What are the pathways from terrorized infant to 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, but there is heterogeneity of impact. 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 (for review see Pynoos, 1990; Schwarz and Perry, 1994). Under all circumstances, however, the organ which allows the child victim to adapt to any 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 its birthplace -- 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 all solely 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) by its most complex cortical structures. The 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 (see below). As the brain develops in this sequential and hierarchical fashion, as the more complex limbic, sub-cortical and cortical areas organize, they begin to modulate, moderate and 'control' the more primitive and 'reactive' lower portions of the brain (Figure 2). These various brain areas develop, organize and become fully functional at different stages during childhood (Singer, 1995). At birth, for example, the brainstem areas responsible for regulating cardiovascular and respiratory function must be intact while the cortical areas responsible for abstract cognition have years before they are required to be fully-functional. A frustrated three year old (with a relatively unorganized cortex) 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 'built in' the capacity to modulate and inhibit those urges. All theoretical frameworks in developmental psychology describe this sequential development of ego-functions and super-ego which are, simply, cortically-mediated, inhibitory capabilities which modulate the more primitive, less mature, reactive impulses of the human brain. Loss of cortical function through any variety of pathological process (e.g., stroke, dementia) 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). Conversely, any deprivation of optimal 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 to violent behavior (see Figures 5 and 7).

Essential to understanding the neurobiology of violence is this: 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 display violence (Halperin et al., 1995) 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.

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 (see 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 depend upon the presence and the nature of the child's total sensory experience (e.g., Kandel, 1989; Goelet et al., 1986; Thoenen, 1995).

Different areas of the CNS are in the process of organization at different times. During these critical periods of primary neural system organization, the brain requires and is most sensitive 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 immutable neurophysiological chain of development is that, again, early life experiences have disproportionate 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 fancy sneakers he wants. Another child is wearing them -- so he pulls out a gun and demands them. The younger child, at gunpoint, takes off his shoes and surrenders them. The fifteen year old puts the gun to the child's head, smiles and pulls the trigger. When he is arrested, the officers are chilled by his apparent lack of remorse. Asked later whether, if he could turn back the clock, would he 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 remorse -- an affect -- is absent. He feels no connection to the pain of his victim. Neglected and humiliated by his primary caretakers when he was young, this fifteen year old murderer is, literally, emotionally retarded. The part of his brain which would have allowed him to feel connected to other human beings -- empathy -- simply did not develop. He has affective blindness. Just as the retarded child lacks the capacity to understand abstract cognitive concepts, this young murderer lacks the 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 (e.g., Singer, 1995; Thoenen, 1995). Absent such experience and development, dysfunction is inevitable (e.g., Carlson et al., 1989). When 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 (e.g., 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 or abandoned early in life will exhibit attachment problems which are persistently resistant 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 (Chisholm et al., 1995) and, sadly, the remorseless, violent child (Ressler et al., 1988; Myers et al., 1995; Mones, 1991; Hickey, 1991; Greenberg et al., 1993).

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 (Lewis et al., 1989). So often, these acts are inhuman -- throwing a six year old boy out of a window because he refused to steal candy for you -- planning, stalking, kidnapping and torturing someone who 'disrespected' you -- hunting any homeless man to set 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 emotional attachment to any human being, then one cannot expect any more remorse from him 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 in which they have been raised (Taylor et al., 1992; Perry, Pollard, Blakley, Baker, & Vigilante, in press).

It is important to emphasize that the majority of individuals who are emotionally neglected in childhood do not grow into violent individuals. These victims 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 (Singer, 1995; Thoenen, 1995; Brown, 1994). 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 (Moffitt et al., 1988; MacEwen, 1994). The human cortex grows in size, develops complexity, makes synaptic connections and modifies as a function of the quality and quantity of sensory experience (Chisholm et al., 1995; Singer, 1995; Courchesne et al., 1994). 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 suffered 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 which subsequently atrophied. These areas, which develop in a use-dependent fashion, were under-used, resulting in profound underdevelopment of these areas. There are multiple examples of the negative impact of environmental deprivation on the developing brain in 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).

A 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 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, and, thus, more capable of modulation of aggressive and violent impulses. The sociocultural phenomenon underlying the development of healthier and more capable cortices was, without question, 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 have yet to be fully realized. Ominous clues abound, however (Donnerstein et al., 1995). American children raised on Sesame Street and MTV are impatient with even moderately slow presentations of any stimuli, written, spoken, or visual (Carnegie Council on Adolescent Development, 1995). 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 22,000 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 markedly different from the one in which our brains developed.

Traumatic Violence: The Persisting State of Fear

Children exposed to chronic violence are more likely to be violent (e.g., Loeber et al., 1993; Lewis et al., 1989; Koop et al., 1992; Hickey, 1991; Halperin et al., 1995). This is related to many factors, including modeling and learning that violent aggression is acceptable, even a preferable and honorable, solution to problems. 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 just 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 (Perry, 1994; Perry, 1996).

If during development, this stress response apparatus is required to be persistently active, a commensurate 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 a 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). In most cases, however, these "survival tactics" ill-serve the child when the environment changes.

Clinically, this is very easily observed 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. It is not that they have a core abnormality of their capacity to attend to a given task, it is that they are hypervigilant. These children have behavioral impulsivity and cognitive distortions (Pynoos et al., 1985; Pynoos, 1990), all of which result from a use-dependent organization of the brain (Perry, Pollard, Blakley, Baker, & Vigilante, in press). During development, these children spent so much time in a low-level state of fear (mediated by brainstem and midbrain areas) that they were focusing consistently on non-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, 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 -- with violence often being employed as a "tool". 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).

These children are also characterized by persisting physiological hyperarousal and hyperactivity (Perry, 1995a; Perry, et al., in press). They 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 generalized (or specific) 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). Using continuous heartrate monitoring during clinical interviews, male, pre-adolescent children exposed to violence exhibited a mild tachycardia during non-intrusive interview and a marked tachycardia during interviews about specific exposure to trauma ($n = 83$; resting heartrate = 104; interview heartrate = 122). In comparison, females exposed to traumatic events tended to have normal or mild tachycardia which, during interviews about the traumatic event decreased ($n = 24$; resting heartrate = 98; interview heartrate = 82). This gender difference was associated by differences in emotional and behavioral symptoms, with males exhibiting more 'externalizing' and females more 'internalizing' symptoms (Perry, et al., 1995b; Perry, et al., in press;).

In our work with another population of boys exposed to severe prolonged domestic violence ($n = 65$) at a residential treatment center, a subset of the hyperaroused, reactive boys ($n = 65$ total; predatory subset = 12) developed predatory aggressive behaviors. In early adolescence, this subset of boys actually had a normalization of the tachycardia noted when they were younger. Indeed, they began exhibiting decreases in heartrate when asked to discuss specific violent events they had been involved in. Some of these youth described a soothing, calming feeling when they began 'stalking' a potential victim. The detached, calm, dissociated (and re-inforcing) feeling these boys felt is reminiscent of the feelings described by borderline adolescent girls who cut themselves and may be related to an endogenous opioid release similar to that seen in various dissociative states (Perry, in preparation). These preliminary observations are consistent with recent reports of the physiological differences between a cohort of 15 year old antisocial youth followed to age 29. In the group which by age 29 had become criminal, resting heartrates were much lower than controls and the comparison antisocial cohort (Raine et al., 1995).

The implications of this for the violent youth are profound. 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 display 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 as threatening and will, being more reactive, respond in a more impulsive and violent fashion. Literally, using the original (childhood) adaptive "fight or flight" response in a new context but, now, later in life, in a maladaptive fashion.

Finally, this reactivity of response is profoundly exaggerated by the influence of alcohol or other drugs (Shupe, 1954; Lindqvist, 1986; Cordilla, 1985). 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 (Wolfgang et al., 1967). Some are defensive, some are predatory, some are impulsive. All of these pathways, however, are facilitated by the individual practitioner's belief system (MacEwen, 1994; Burton et al., 1994). The majority of neglected children never become violent. The majority of traumatized children never become violent (e.g., Belmore et al., 1994). 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, idealization of violent "heroes", cultural tolerance of child maltreatment, tribalism, jingoism, nationalism -- all unleash, facilitate, encourage, and nurture violent individuals. Without these facilitating belief systems and modeling, neglected and abused children would carry their pain forward in less violent ways -- as silent, scarred, adult members of the vast army one commentator has termed the "Children of the Secret" (Vachss, 1991).

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 various 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 metastasized 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 (Radke-Yarrow et al., 1995), chaotic and cognitively impoverished environments (Carlson et al., 1989), pervasive physical threat (O'Keefe, 1995), persisting fear (Schwab-Stone et al., 1995) 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 (Miedzian, 1991) 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." Nowhere is this predatory food chain more evident than in juvenile justice settings where, too often, the youth is either victim or predator -- with no third option. Due to clear socio-cultural devolution in some segments of our communities, there are more and more undersocialized, traumatized children (Horowitz et al., 1995; Carnegie Council on Adolescent Development, 1995). These children get little cognitive stimulation -- the public schools are falling apart; their lives are devoid of emotional contact -- mom is a child herself and pregnant again; no predictability, structure or nurturing can be found out of the home -- the community has dissolved.

Clinical Implications

There are a variety of important clinical considerations when examining the interplay between developmental trauma and brain development. One of the most obvious is the developmental stage at which it occurs. What may be partially 'absorbable' at age 15 may be devastating at age 5. 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 (and reality of) threat, the degree to which body integrity and life-threatening experiences take place, and the presence of protective factors all 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 even outside the home (for review see Pynoos, 1990; Schwarz and Perry, 1994).

Predictability of threat is important in determining the impact of a trauma. 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 a promote either physical or sexually abuse. A child who has been a victim of unpredictable sexual or physical abuse learns (consciously or unconsciously) 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 their 'environment'. This behavior is often misinterpreted, and the school or foster placement will punish them severely (often following a restraint situation), thereby re-enforcing 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 those designed for purely impulsive, reactively 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 (Ungerleider, 1995; Maunsell, 1995). These powerful principles of neurophysiological functioning relate back to the way in which the brain internalizes new information -- in a use dependent fashion. The only parts of the brain which can change are those parts which are on -- those that are being used. So that when asleep, storage of information -- or recall of previously stored information from parts of the brain that are active only during waking hours is impossible. This state-dependence is very important in the clinical approach to the traumatized child. 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 accompany this. Only when significantly 'calmed' will these children benefit from 'words.' What we can expect children 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 (re)act accordingly. It is the task of therapeutic interventions to begin to provide a set of consistent 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 a perceived-threat situation. When a child or adolescent sits quietly in a room with peers and can think through a situation, non-violent resolution comes more 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 virtually impossible. And any mistakes could be fatal.

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 failed parents and children alike. 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 (Kendall et al., 1995; Urquiza et al., 1994; Klee et al., 1987; McIntyre et al., 1986; Carnegie Council on Adolescent Development, 1995).

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 its young, 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 learn the truth.

Acknowledgments

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FIGURES

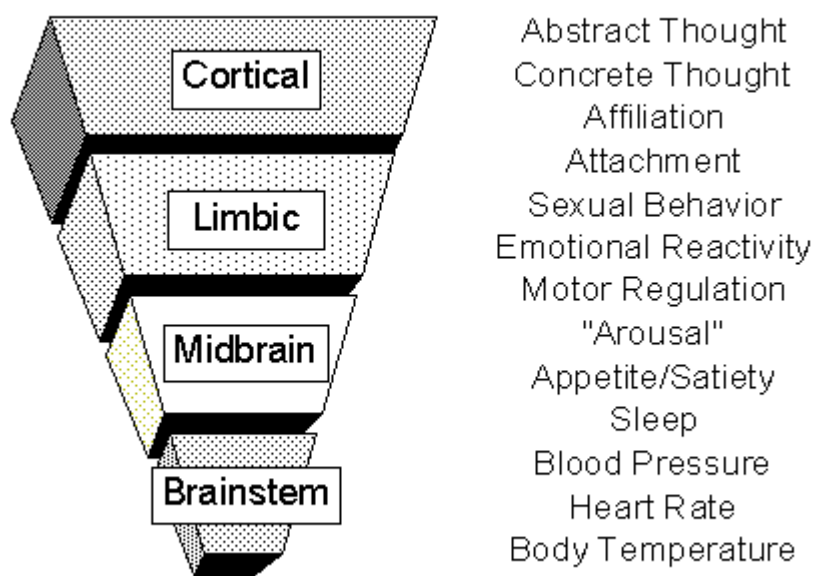


FIGURE 1. Hierarchy of Brain Function. The human brain is organized from the most simple (e.g., fewest cells: brainstem) to most complex (e.g., most cells and most synapses: frontal cortex). The various functions of the brain, from most simple and reflexive (e.g., regulation of body temperature) to most complex (e.g., abstract thought) are mediated in parallel with these various areas. These areas organize during development and change in the mature brain in a 'use-dependent' fashion. The more a certain neural system is activated, the more it will 'build in' this neural state -- creating an internal representation of the experience corresponding to this neural activation. This use-dependent capacity to make internal representations of the external or internal world is the basis for learning and memory.

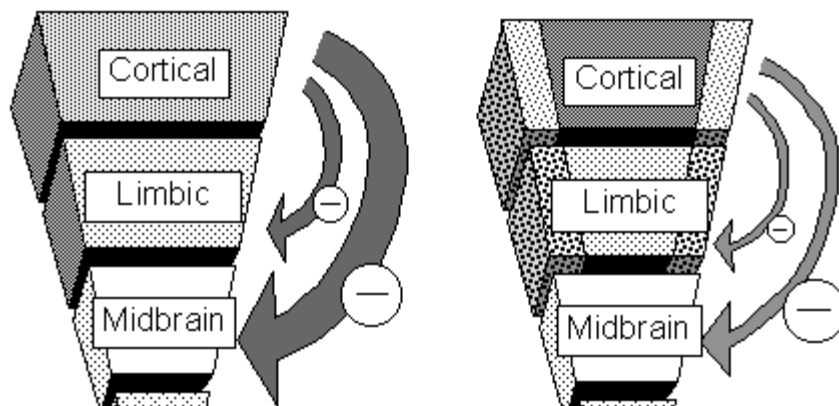




FIGURE 2: Cortical Modulation: The capacity to moderate frustration, impulsivity, aggression and violent behavior is age-related. With a set of sufficient motor, sensory, emotional, cognitive and social experiences during infancy and childhood, the mature brain develops - in a use-dependent fashion --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

Optimal Developmental Experience

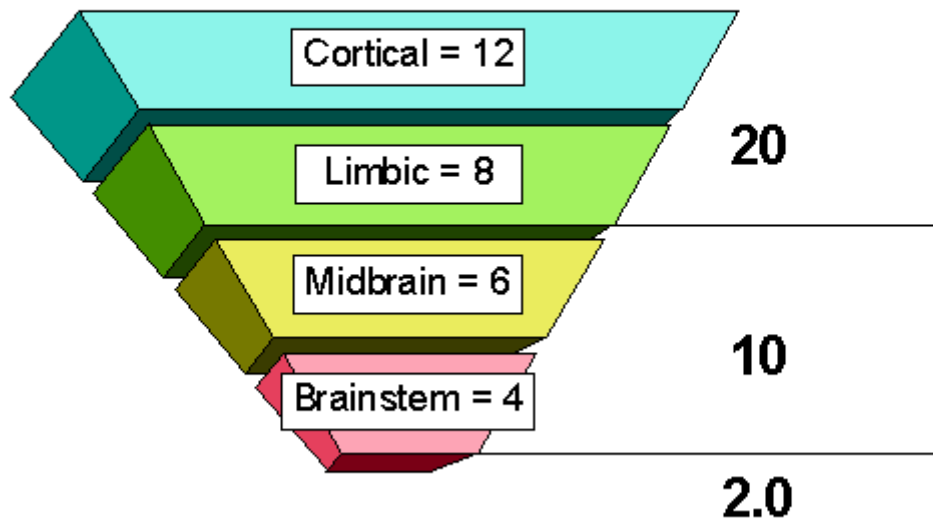
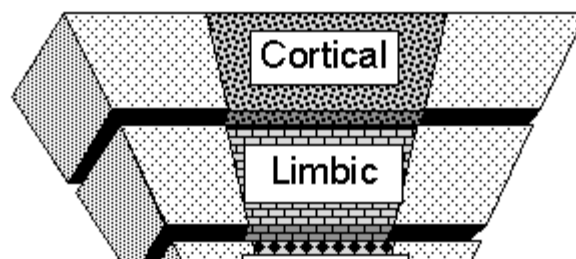


FIGURE 3. Ratio of Modulation: Optimal Development. A healthy Cortical Modulation ratio (Cortical and Limbic/Midbrain and Brainstem) develops when the child experiences a variety of optimal emotional, behavioral, cognitive and social experiences at key times during their development. This ratio indicates 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.



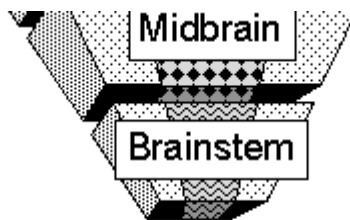


FIGURE 4. Sequential Development of the Brain. The simple and unavoidable result of this sequential neurodevelopment is that the organizing, 'sensitive' brain of an infant or young children is more malleable to experience than a mature brain. While experience may alter and change the functioning of an 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

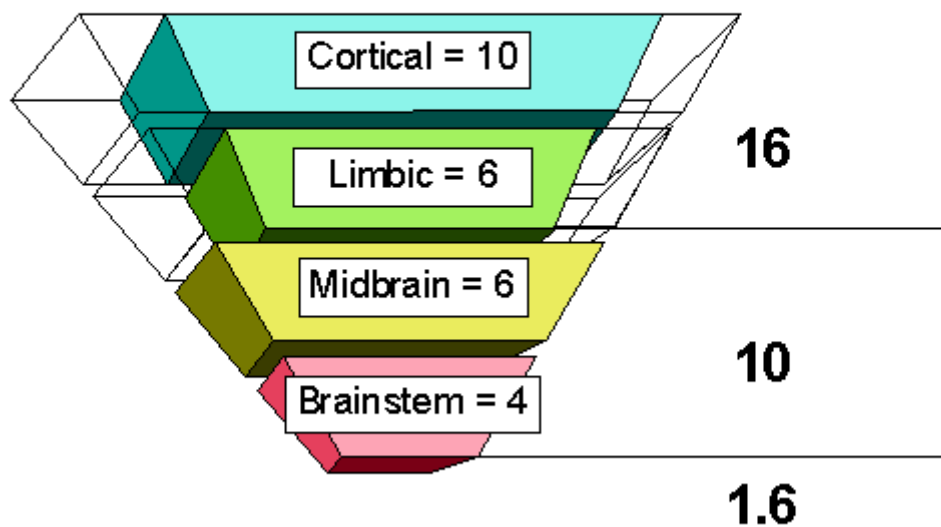
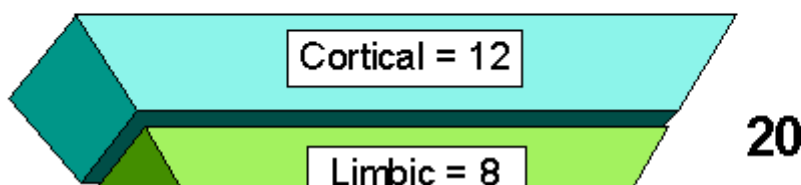


FIGURE 5. Developmental Neglect: Emotional or Experiential Deprivation. The ability of the brain to develop a healthy Cortical Modulation ratio (Cortical and Limbic/Midbrain and Brainstem) is impaired when key experiences are minimal or absent. This results in poor modulation of impulsivity, persisting '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.

Developmental Trauma



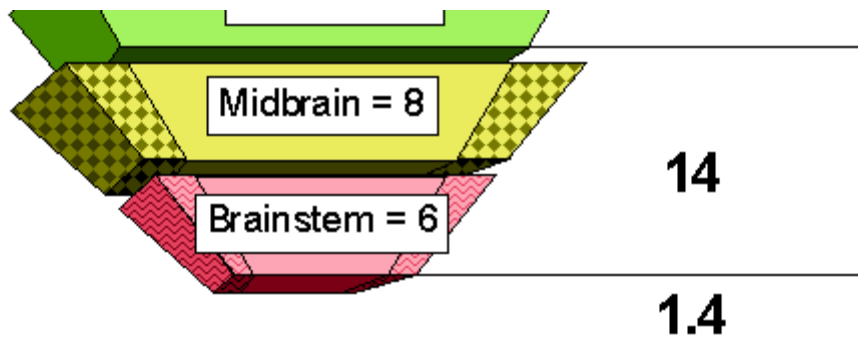


FIGURE 6. The Persisting Fear Response: Developmental Trauma. A child raised in an environment characterized by persisting trauma (e.g., domestic violence, physical abuse, community violence) will develop an excessively active and reactive stress-response apparatus. The majority of the stress response 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

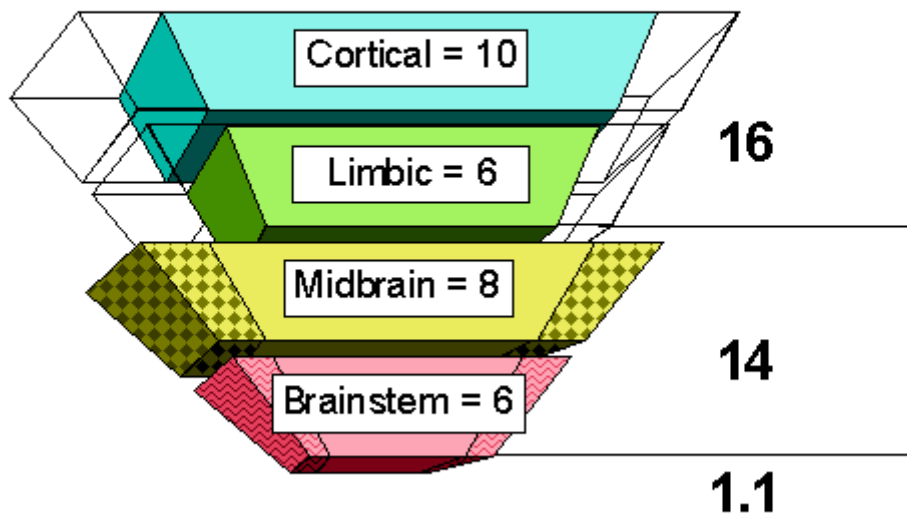
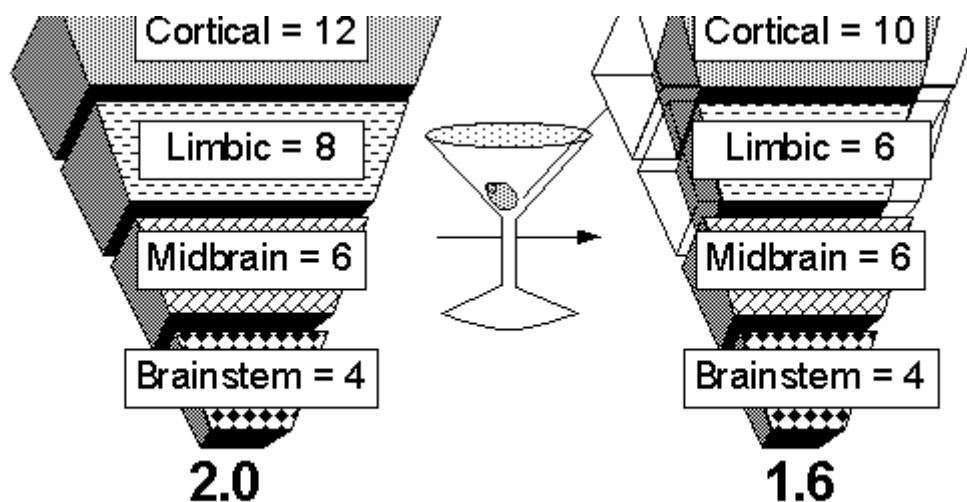


FIGURE 7. Neglect and Trauma: The Malignant Combination. Developmental neglect or traumatic stress during childhood can profoundly alter development. Unfortunately, emotional and cognitive neglect usually occur in combination with traumatic stress. The combination of a lack of critical emotional experiences 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*

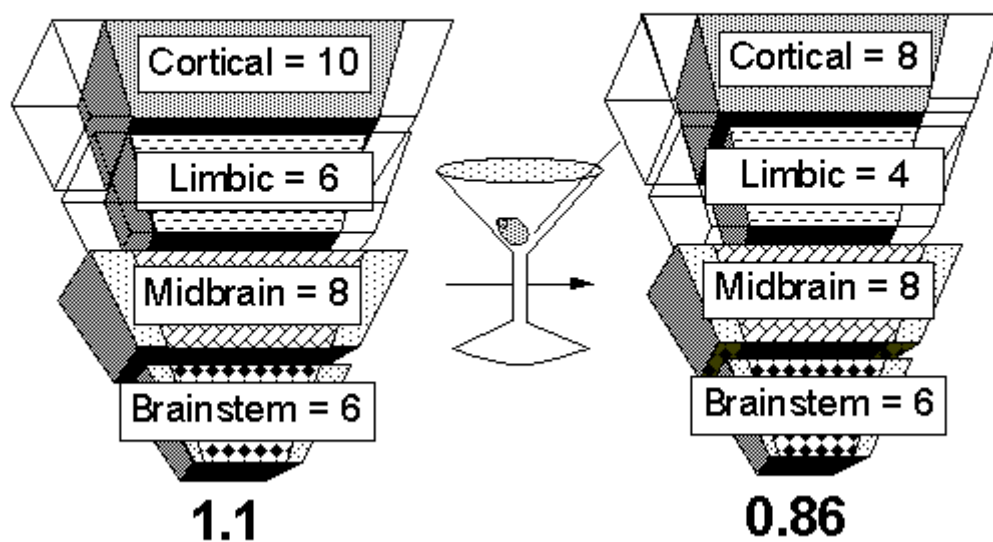


FIGURE 8. Alcohol Decreases the Cortical Modulation Ratio. Upper Panel. Alcohol has a well-documented relationship to violent behavior. Under optimal circumstances, drinking can decrease judgment, impair capacity to modulate impulsivity and predispose to aggressive and violent behaviors. Alcohol does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

Malignant Combinations

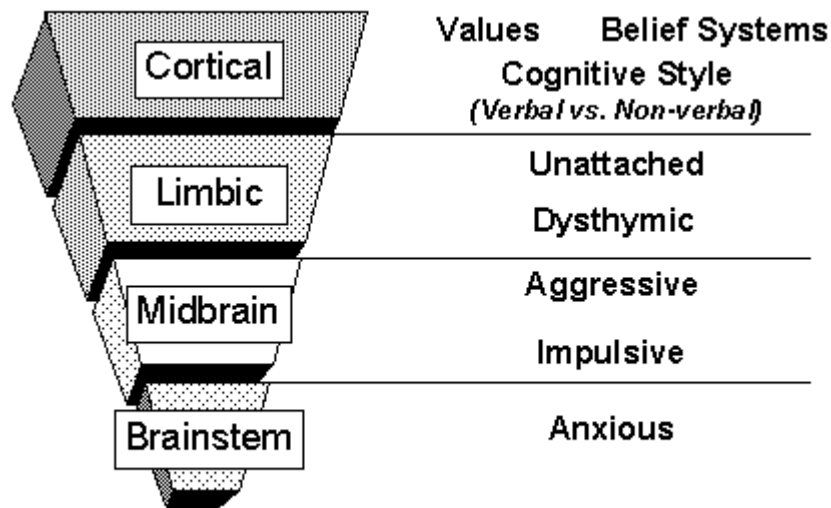


FIGURE 9. Malignant Combination of Experience: Neurodevelopmental experiences of trauma or neglect alter a variety of brain areas and functions important in predisposing to violence. Depending upon the time in development, the nature (trauma, neglect or both) and extent of the abuse and the presence 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 problem-solving styles which predispose to violent solutions. Ultimately, however, being anxious or impulsive or depressed or unattached or cognitively-impaired do not compel violence by individuals. 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.

I