Neurodevelopmental Adaptations To Violence:
How Children Survive The Intragenerational Vortex Of Violence

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INTRODUCTION

Childhood is a dangerous time. For centuries, children, the most vulnerable of our species, have struggled to survive this harsh world. For infants and children, survival is dependent upon adults, most typically, the nuclear family. It is in the family setting that the child is fed, clothed, sheltered, nurtured and educated, directly and indirectly, in the language, beliefs, and value systems of the culture. It is in the family setting in which the non-genetic 'DNA' of the culture is transmitted from generation to generation, allowing the amazing process of socio-cultural evolution.

When the child's development is characterized by structure, predicability, nurturing, and enriching emotional, social and cognitive experiences, a vulnerable and powerless infant can grow to become a happy, productive, insightful and caring member of society -- contributing to us all. Sadly, few families and communities can provide this idealized early life. Indeed, it is in the familial incubator that children are most frequently manipulated, coerced, degraded, inoculated with destructive beliefs and exposed to violence.

The home is the most violent place in the United States (see below). This violence takes many forms. When violence is present in the home, the child will be exposed to a variety of destructive experiences. The child may witness the assault of her mother by father or boyfriend. The child may be the direct victim of violence -- physical or emotional -- from father, mother or even older siblings. The child may become the direct victim of the adult male if he or she tries to intervene and protect mother or sibling. Despite the attention paid to the violence committed by males in the street, there is good evidence to suggest that the majority of the violence directed at young children in the home comes from the mother - and older siblings (Department of Justice, 1990). While this is often physical violence, a more destructive element of this intrafamilial toxicity is emotional violence -- humiliation, coercion, degradation, threat of abandonment or physical assault. Indeed, emotional abuse may be more destructive to the development of the child than physical assault (Vachss, 1993).

In homes where no physical or emotional violence is present, children are still bathed in violent images -- the average child spends more time watching television than any other waking activity { }. Television has become increasingly violent. Estimates of the number of murders viewed by an American child by age 18 range from 20,000 to 75,000 { }. With the solid emotional, behavioral, cognitive and social anchors provided by a healthy home and community, this pervasive media violence does not 'cause' violence but it does contribute to a pervasive view that the world is a much more dangerous place than it really is { }. In children exposed to

violence in the home, these media images of power and violence are major sources of 'cultural' values, reinforcing what they have seen modeled at home. And the beliefs and actions of all children reflect the world they are raised in. The violence in our streets started in our homes.

The purpose of this paper is to describe how children survive in this 'vortex' of violence. Persisting threat results in persisting fear. Persisting fear and adaptations to the threat present in the vortex of violence alter the development of the child's brain, resulting in changes in physical, emotional, behavioral, cognitive and social functioning. These changes in the developing child, in turn, contribute to the transgenerational cycle of violence as these young children become adolescents -- and finally, the adults that shape our society, the adults that choose and determine our cultural values, the adults that raise the next generation of children in a new intragenerational vortex of violence.

THE VORTEX OF VIOLENCE

Violence in the Home

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; Perry, in press). 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 and the impact of abuse and neglect on the development of the child are examined. The adolescents and adults responsible for violence in the community developed 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; Perry, in press).

Most violence against men is committed by men. Most violence committed against women is committed by men. Most violence against children is committed by women. Most violence committed by children is against other children. Most violence against pets is committed by children. The intergenerational 'cycle of violence' is well documented. This intragenerational 'vortex of violence' is not. The majority of our violence initiatives and examinations of violence focus on violence of a specific type -- violence committed against voters (typically property owners). Indeed if one man hits another man (especially one with a job), this is a felony - assault and battery, while the same physical violence against a wife or a child is culturally sanctioned, often rationalized as 'deserved' or 'discipline'. Prosecution of the former would proceed, prosecution of the latter would never be pursued. Indeed the victim would often be openly or tacitly riduculed, and made to feel responsible -- "they deserved it."

The vortex of violence is fueled by the 'conservation of violence'. When you are helpless, frustrated, humiliated and overwhelmed, it is common to bring this into your interactions with others. If the other is smaller and weaker, it is likely that the direction of frustration and violence will be from more powerful to least powerful. A typical flow of rage will start with a man frustrated and humiliated outside of the home. He will absorb this humiliation, modify some of it, and pass some on. At home, he will direct his anger and rage at his spouse -- she will absorb, modify and pass on. The overwhelmed and assaulted mother (usually when father leaves) will pass the humiliation and violence to the demanding children. These older children will absorb, modify and pass on -- to younger or weaker children. The child at the center of the vortex may have no human to 'pass on' to -- they will absorb, accumulate, wait until they are old enough, big

enough, strong enough to hurt humans -- or they may pass on to animals. More cats are killed by children than by dogs.

Living in this vortex of violence creates violent children. And what this process costs in robbed emotional, social, cognitive and physical is incaculable. Different individuals 'absorb' better -- and pass on less. Yet they pay one way or the other -- absorb and modify -- creating anxiety, depression, cognitive impairment -- and, often violence. It is the rare and strong person that can carry their trauma without having it spill into the next generation. For as many individuals that carry their pain, there are those that pass their's on -- not to just one but to many. Violence of one person can leave a wake of destruction in the lives of hundreds.

Violent Youth

There has been an dramatic increase in juvenile violence over the last 20 years { }. The majority of the initiatives dedicated to studying and intervening in violence have focused on violence committed by males. While the vast majority of violence against women is committed by men, the majority of direct violence to children takes place in the home

The children who grow up to be violent in the streets are the products of this vortex of violence within the very environments entrusted to nurture, protect and educate them -- the home. These children are the products of their environments, adapted to living in a situation of pervasive threat, with all the expected adaptations in emotional, behavioral, cognitive, social and physiological functioning. The vortex of violence creates a pervasive sense of threat -- an incubator of terror -- for the developing child. The results are predictable.

Children raised in the vortex of violence are much 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 (see Figure 4). "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." 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).

Neurodevelopment and the Threat Response

A growing body of evidence suggests that the developing brain organizes in reponse to the pattern, intensity and nature of sensory perceptual and affective experience of events during childhood (see Perry, 1993; 1994; Perry et al., 1995). Mediated by neurotransmitters and hormones, the stress responses can affect the development of the brain by altering neurogenesis, migration, synaptogenesis, and neurochemical differentiation (Lauder, 1988; for review Perry, 1994). Indeed, the developing brain is exquisitely sensitive to stress. For example, rats exposed to perinatal handling stress show major alterations in their stress response later in life (Plotsky and Meany, 1993). Such studies suggest that early exposure to consistent, daily stress can result in more adaptive later behavior and resiliency, while exposure to unpredictable stress can result in deficits. Predictability and control can make events much less destructive or traumatic.

The human brain changes in a 'use-dependent' fashion (for review see Perry et al., 1995). Neural systems that are activated change in permanent ways, creating 'internal' representations -- literally, memories. The brain makes cognitive memories, emotional memories, motor-vestibular memories and state memories. The physiological hyperarousal state associated with fear and pervasive threat results in a brain that has created all of these memory types (i.e., cognitive, motor, emotional, state) and in doing so has adapted to a world characterized by unpredictability and danger. The brains of traumatized children develop to be hypervigilant and focused on non-verbal cues, potentially related to threat. These children are in a persisting state of arousal and, therefore, experience persisting anxiety.

If during development, the threat response apparatus is required to be persistently active, a commesurate 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. While these adaptive changes in the brain make a child better suited to sense, perceive and act on threat in their world these "survival tactics" ill-serve the child when the environment changes (e.g., in school, peer relationships: see Figs. 3 and 4).

These children are characterized by persisting physiological hyperarousal and hyperactivity (Perry, 1995a; Perry, et al., 1995). 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;).

The implications of this for the violent youth are profound. First, any child in the vortex of violence will develop a persisting fear-response. There are marked gender differences in this response (Perry et al., 1995b; Perry, Pollard, Blakley, Baker, & Vigilante, 1995). Females more likely to dissociate and males more likely to display a classic "fight or flight" response. As a result, more males will develop the aggressive, impulsive, reactive and hyperactive symptom presentation. Males will more likely be violent outside the home and with women (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.

In turn, the battered and overwhelmed woman will be more violent and abusive to her children. Women are more violent to children in the home than men. This may be due to the fact that they are often not in the home. It is also likely that when the direct object of their rage and violence can be the mother, it will be. If an older, typically male, child tries to defend the mother, the male

will be physically abusive. But on the whole, the traumatized, unsupported and frustrated mother is more likely to be the perpetrator of emotional and physical abuse to children in the home.

CLINICAL IMPLICATIONS

There are profound clinical implications of the persisting arousal states in children. These children will have impaired capacities to benefit from social, emotional and cognitive experiences. This is explained by three key principles of brain functioning: 1) the brain changes in response to experience in a 'use-dependent' fashion; 2) the brain internalizes and stores information from any experience in a 'state-dependent' fashion and 3) the brain retreives stored information in a state-dependent fashion.

Use-dependent Learning: State Dependent Storage and Recall

As described above, the brain changes in a use-dependent fashion. All parts of the brain can modify their functioning in response to specific patterns of activation -- or to chronic activation. These use-dependent changes in the brain result in changes in cognition (this, of course, is the basis for cognitive learning), emotional functioning (social learning), motor-vestibular functioning (e.g., the ability to write, type, ride a bike) and state-regulation capacity (e.g., resting heartrate). No part of the brain can change without being activated -- you can't teach someone French while they are asleep or teach a child to ride a bike by talking with them.

Mismatch between modality of teaching and the 'receptive' portions of a specific child's brain occur frequently. This is particulary true when considering the learning experiences of the traumatized child -- sitting in a classroom in a persisting state of arousal and anxiety -- or dissociated. In either case, essentially unavailable to process efficiently the complex cognitive information being conveyed by the teacher. This principle, of course, extends to other kinds of 'learning' -- social and emotional. The traumatized child frequently have significant impairment in social and emotional funtioning. These capabilities develop in response to experience -- experiences which these children often lack -- or fail at. Indeed, hypervigilant children frequently develop remarkable non-verbal skills in proportion to their verbal skills (street smarts). Indeed, often they over-read (misinterpret) non-verbal cues -- eye contact means threat, a friendly touch is interpreted as an antecedent to seduction and rape -- accurate in the world they came from but now, hopefully, out of context. 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 clinic population, children raised in chronically traumatic environments demonstrate 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".

This principle is critically important in understanding why a traumatized child -- in a persisting state of arousal -- can sit in a classroom and not learn. The brain of this child has different areas activated -- different parts of the brain 'controlling' his functioning. The capacity to internalize new verbal cognitive information depends upon having portions of the frontal and related cortical areas being activated -- which, in turn, requires a state of attentive calm. A state the traumatized child rarely acheives.

Children in a state of fear retreive infomation from the world differently than children that feel calm (see Figures 1, 3 and 4). We all are familiar with 'test' anxiety. Imagine what life would be like if all experiences invoked the persisting emotion of anxiety. If a child has information stored in cortical areas but in the specific moment is very fearful, this information is inaccessible. In this regard, cognitively-stored information does little good in the life-threatening moment. Simple didactic conflict-resolution models are doomed to fail unless they involve elements of role-playing. Imagine how much you would trust an Army that went through combat training by sitting in classroom -- or the E.R. physician about to run her first code after only leaning how to do that by reading a book. In the midst of most threatening experiences -- situations where violence often takes place -- the 'problem-solving' information in the cortex is not easily accessed. It is of interest to note that information learned in song, rhyme or rap is more easily recalled when in a state of high arousal. This is due, of course, to the fact that this information is stored in a different fashion than traditional verbal cognitive information.

Decreasing the Alarm State: Elements of Therapeutic Interaction

How do you begin to help the traumatized child -- the child that has been living in the vortex of violence. The frustrating fact is that whether teacher, case worker, mental health professional, pediatrician, police officer or any other caring adult, we often are unable to remove a child from the Vortex. We see the impact, we know the home, the community, the peer group, the gang will stay the same. We know that for '24-7' the child is in settings where we may have no control or impact. This need not be reason for despair -- motivation for outrage and action, yes -- but not hopelessness.

An amazing quality of the human brain is to create an image of the future. To make an internalization of a better place, a better way, a better life, a better world. This capacity is called hope. We can give children hope that not all adults are inattentive or abusive or unpredictable or violent. Some of the most influential people in any person's life may be someone they have never even met. They have used that person to create an inner image to aspire to, to idealize, to idolize. Role models, mentors, heros -- all can provide critical formative experiences for children.

And what are the qualities that we should introduce into our work to provide the experience for the child which can give them hope and the opportunity for change ? The hallmarks of the transforming therapeutic interaction are safety, predictability and nurturance. The most 'therapeutic' interactions often come from people who have no training (or interest) in psychological or psychiatric labels, theories, treatments and the adult expectations of the child that go with these. In interacting with the child, respect, humor and flexibility can allow the child to be valued as what they are.

Clinical principles for effective work with children have additional critical elements. One is helping the child understand what they feel and why they behave a certain way in given situations. Traumatized children frequently act impulsively and misunderstand why this has happened. They will often explain this (as will the adults around them) as the by product of them being stupid, insensitive, bad, selfish, sick or damaged in some way. The false cognitions of the traumatized child need to be addressed and changed. A second important element of clinical work with traumatized children is educating the adults in the child's world about the ways in which maltreated and traumatized children think, feel and behave. This can lead to understanding rather than rage. If a clinician can make the ten adults in the child's life 5 percent more psychologically understanding, they can increase the number of neutral and positive experiences in the child's life ten fold -- and decrease the number of negative experiences

dramatically. The resulting impact is much more effective than 45 minutes a week in the clinicians office.

There are many more important specific treatment aspects of working with these children that are beyond the scope of this paper. Yet even with optimal clinical 'techniques', treatment of maltreated children would overwhelm the entire mental health and child welfare community in this country. Today the number of children that would benefit from intervention far outstrips the meager resources our society has dedicated to maltreated children. At the end of the day -- and possibly at the end of our society -- we will have to focus on prevention.

PREVENTION and SOLUTION

What we are as adults is the product of the world we experienced as children. The way a society functions is a reflection of the childrearing practices of that society. Today, we reap what we have sown. Despite the well-documented critical nature of early life experiences, we dedicate few resources to this time of life. We do not educate our children about development, parenting or about the impact of neglect and trauma on children. As a society we put more value on requiring hours of formal training to drive a car than we do on any formal training in childrearing.

In order to prevent the development of impulsive, predatory or violent children, we need to dedicate resources of time, energy and money to the complex problems related to child maltreatment. We need to understand the indelible relationship between early life experiences and cognitive, social, emotional, and physical health. Providing enriching cognitive, emotional, social and physical experiences in childhood could transform our culture. But before our society can choose to provide these experiences, it must be educated about what we now know regarding child development. Education of the public must be coupled with the continuing generation of data regarding both the impact of positive and negative experiences on the development of children. All of this must be paired with the implementation and testing of programs dedicated to enrich the lives of children and families and programs to provide early identification of, and proactive intervention for, at-risk children and families.

The problems related to maltreatment of children are complex and they have complex impact on our society. Yet there are solutions to these problems. The choice to find solutions is up to us. If we choose, we have some control of our future. If we, as a society, continue to ignore the laws of biology, and the inevitable neurodevelopmental consequences of our current childrearing practices and policies, our potential as a humane society will remain unrealized. The future will hold sociocultural devolution -- the inevitable consequence of the competition for limited resources and the implementation of reactive, one-dimensional and short-term solutions.

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Ages	30 ← 15	15 ← 8	8 ← 3	3 ← 1	1 ← 0
Developmental Stage	Adult / Adolescent	Adolescent / Child	Child / Toddler	Toddler / Infant	Infant / Newborn
Primary *secondary* Brain Areas	NEOCORTEX / *Subcortex*	SUBCORTEX / *Limbic*	LIMBIC / *Midbrain*	MIDBRAIN / *Brainstem*	BRAINSTEM / *Autonomic*
Cognition	Abstract	Concrete	"Emotional"	Reactive	Reflexive
Mental State	CALM	AROUSAL	ALARM	FEAR	TERROR

Figure 1: When threatened a child is likely to act in an 'immature' fashion. Regression, a 'retreat' to a less mature style of functioning and behavior, is commonly observed in all of us when we are physically ill, sleep-deprived, hungry, fatigued or threatened. As we 'regress', in response to the real or perceived threat, our behaviors are mediated (primarily) by less-complex brain areas. If a child has been raised in an environment of persisting threat, the child will have an altered baseline such that the internal state of calm is rarely obtained.(or only artificially obtained via EtOH or drugs). In addition, the traumatized child will have a 'sensitized' alarm response, over-reading verbal and non-verbal cues as threatening. This increased reactivity will result in a dramatic changes in behavior in the face of seemingly minor provocative cues. All too often, this over-reading of threat will lead to a 'fight' or 'flight' reaction -- and impulsive violence. The child will view their violent actions as defensive.

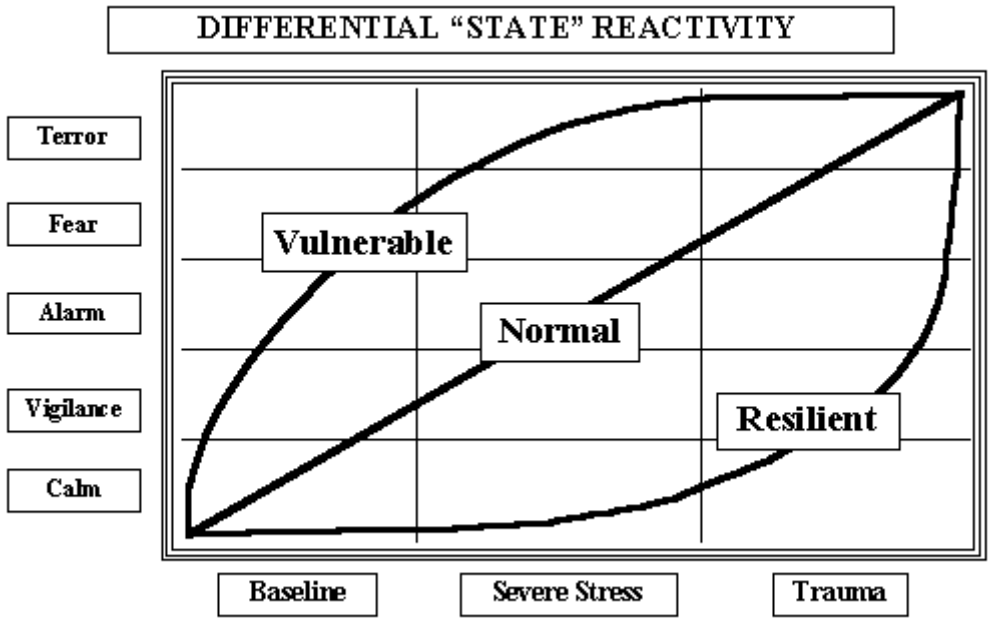

Figure 2: Children exposed to significant threat will "re-set" their baseline state of arousal such that even at baseline -- when no external threats or demands are present, they will be in a physiological state of persisting alarm (top curve: Vulnerable). As external stressors are introduced (e.g., a complicated task at school, a diagreement with a peer) the traumatized child will be more 'reactive' -- moving into a state of fear or terror in the presence of even minor stressors. The cognition and behavior of the child will reflect their state of arousal (see Figures 1, 3 and 4). This increased baseline level of arousal and increased reactivity in response to a perceived threat plays a major role in the associated behavioral and cognitive problems associated with traumatized children.

Adaptive Response	Rest *(Adult Male)*	Vigilance	Freeze	Flight	Fight
Hyperarousal Continuum	Rest *(Male Child)*	Vigilance	Resistance	Defiance	Aggression
Dissociative Continuum	Rest *(Female Child)*	Avoidance	Compliance	Dissociation	Fainting
Mental State	CALM	AROUSAL	ALARM	FEAR	TERROR

Figure 3: Different children have different styles of adaptation to threat. Some children use a

primary hyperarousal response some a primary dissociative response. Most use some combination of these two adaptive styles. In the fearful child, a defiant stance is often seen. This is typically interpreted as a willful and controlling child. Rather than understanding the behavior as related to fear, adults often respond to the 'oppositional' behavior by becoming more angry, more demanding. The child, over-reading the non-verbal cues of the frustrated and angry adult, feels more threatened and moves from alarm to fear to terror. These children may end up in a very primitive "mini-psychotic" regression or in a very combative state. The behavior of the child reflects their attempts to adapt and respond to a perceived (or misperceived) threat.

Sense of Time	Extended Future	Days Hours	Hours Minutes	Minutes Seconds	Loss of Sense of Time
Primary *secondary* Brain Areas	**NEOCORTEX** *Subcortex*	**SUBCORTEX** *Limbic*	**LIMBIC** *Midbrain*	**MIDBRAIN** *Brainstem*	**BRAINSTEM** *Autonomic*
Cognition	Abstract	Concrete	"Emotional"	Reactive	Reflexive
Mental State	CALM	AROUSAL	ALARM	FEAR	TERROR

Figure 4: One of the most important elements of understanding the child living in the Vortex of Violence, is that all humans process, store, retrieve and respond to the world in a state-dependent fashion. When a child is in a persisting state of arousal due to persisting exposure to threat, the primary areas of the brain which are processing information are different from those in a child who can be calm. The calm child may sit in the same classroom next to the child in an alarm state, both hearing the same lecture by the teacher. Even if they have identical IQs, the child that is calm can focus on the words of the teacher and, using neocortex, engage in abstract cognition. The child in an alarm state will be less efficient at processing and storing the verbal information the teacher is providing. This child's cognition will be dominated by sub-cortical and limbic areas, focusing on non-verbal information -- the teachers facial expressions, hand gestures, when she seems distracted. And, because the brain internalizes (i.e., learns) in a 'use-dependent' fashion, this child will have more selective development of non-verbal cognitive capacities. The children raised in the vortex of violence have learned that non-verbal information is more important than verbal -- "when daddy smells like beer and walks funny, I know he will hurt mommy."

As a child moves along the continuum of arousal, the part of the brain which is 'orchestrating' functioning shifts. This process reflects ontogeny, such that the more distressed one is , the more primitive are the brain areas responsible. An important reflection of this is how the sense of time is altered in alarm states. Sense of future is foreshortened. The critical time period for the individual shrinks. The threatened child is not thinking (nor should she think) about months from now. This has profound implications for understanding the cognition of the traumatized

child. Immediate reward is most reinforcing. Delayed gratification is impossible. Consequences of behavior become almost inconceivable to the threatened child. Reflection on behavior -- including violent behavior -- is impossible for the child in an alarm state. Cut adrift from internal regulating capabilities of the cortex, the brainstem acts reflexively, impulsively, aggressively -- to any perceived threat. Eye-contact for too long becomes a life-threatening signal. Wearing the wrong colors.-- a hand gesture -- cues that to the calm adult reading about another 'senseless' murder in the paper are insignificant but to the hypervigilant, armed adolescent born and raised in the vortex of violence, enough to trigger a 'kill or be killed' response.