



# Traumatic Occurrences as a Trajectory for Structural and Functional Brain Disorders

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## ABSTRACT

This article reviews studies on trauma and its effect on the structural and functional capabilities of the human brain. The studies demonstrate that trauma is an experience that can transform a child's world into a terror-filled, confusing miasma that so dramatically alters the child's trajectory into and throughout adult life. It is the brain that mediates all emotional, cognitive, behavioral, social, and physiological functioning as such it can internalize traumatic experiences. Memories associated with trauma are implicit, pre-verbal and cannot be recalled, but can be triggered by stimuli from the in vivo environment. Understanding the organization, function, and development of the human brain, and brain-mediated responses to threat, provides the keys to understanding the traumatized child. Multidisciplinary research efforts and Community education programs are recommended to address this problem.

**Keywords:** Traumatic Occurrences, Structural And Functional Brain Disorders

## INTRODUCTION

Trauma is the result of an overwhelming amount of stress that exceeds one's ability to cope, or integrate the emotions involved with that experience. Stress is a condition in which an individual experience challenges to physical or emotional well-being that overwhelm their coping capacity. It is not only limited to isolated incidents as the traditional definition of stress may have it but a whole set of environmental factors that have adverse effect on the individual's well-being. Kaufman & Charney (2001) holds that while some experiences with manageable stress condition is important for healthy development, prolonged uninterrupted, overwhelming stress can have toxic effects. When the human brain is developing, it is particularly sensitive to environmental influences as such toxic stress may induce persistent hyper-sensitivity to stressors and sensitization of neural circuits and other neurotransmitters systems which process threat information. These may promote the development of short term and long term cognitive, behavioral and emotional problems that may persist and increase the risk for psychopathology and physical health disorders into adulthood.

## BACKGROUND TO THE STUDY

According to Hoffman, Bose, Batts, Glasheen, Hirsch, Karg, and Hedden, (2016,) for children to develop and flourish in abilities like grit, resilience, self - control, and more they need to spend much time in environments where they feel a sense of belonging. A family's ethnicity, wealth, education, or social standing do not preclude, or inherently predict, whether a child will, or will not, experience stress. We cannot change the families into which children are born nor, can we identify, understand, and resolve all family problems. But our country can resolve its problems so as to create a friendly environment which can enable the development of needed abilities in children, adolescence and young adults. Thus stress ignited by the environment can be effectively eradicated for a healthy brain development.

According to Segal, Smith, Segal, & Robinson (2018), millions of children across the world are exposed to traumatic experiences such as: physical or sexual abuse, living in the fallout zone of domestic or community violence, surviving a serious car accident and more. Depending on the severity, frequency, nature, and pattern of traumatic events, at least half of all children ex-posed may be expected to develop significant emotional, behavioral, physiological, cognitive, and social disorders later on in life. The type of trauma and the timing of that stress determine whether and how there is an impact on the brain. The National Scientific Council on the Developing Child (2014) outlines three classifications of stress:

**Positive stress:** this is moderate, brief, and generally a normal part of life (e.g., entering into a new school). Learning to adjust to this type of stress is an essential component of healthy development.

**Tolerable stress:** this includes events that have the potential to alter the developing brain negatively, but which occur infrequently and give the brain time to recover (e.g., the death of a loved one).

**Toxic stress:** this has to do with strong, frequent, and prolonged activation of the body's stress response system (e.g., chronic neglect, community violence).

Though there are three main categories of stress it could be classified into two broad areas: domestic and community based stress.

Hoffman, Bose, Batts, Glasheen, Hirsch, Karg, & Hedden, (2016,) holds that trauma is the result of an overwhelming amount of stress that exceeds one's ability to cope, or integrate the emotions involved with that experience. It may result from a single distressing experience or repeating events of being overwhelmed that can be precipitated in weeks, years, or even decades as the person struggles to cope with the immediate circumstances, eventually leading to serious, long-term negative consequences. If trauma is often the result of an overwhelming amount of stress that exceeds one's ability to cope, or integrate the emotions involved with that experience, then we can say that not all people who experience a potentially traumatic event will actually become psychologically traumatized.

According to the DSM-5, a traumatic event is defined as exposure to actual or threatened death, serious injury or sexual violence. Exposure to this event can occur through either the direct experience of a traumatic event, witnessing a traumatic event in person, learning that a traumatic event happened to a friend or family member, or through experiencing repeated or extreme exposure to the aversive stimuli of a traumatic event through one's job.

Trauma is an experience. How is it that this experience can transform a child's world into a terror-filled, confusing miasma that so dramatically alters the child's trajectory into and throughout adult life? Ultimately, Memories associated with trauma are implicit, pre-verbal and cannot be recalled, but can be triggered by stimuli from the in vivo environment. The human brain processes and internalizes traumatic experiences. It is the brain that mediates all emotional, cognitive, behavioral, social, and physiological functioning. It is the human brain from which the human mind arises and within that mind resides our humanity. Understanding the organization, function, and development of the human brain, and brain-mediated responses to threat, provides the keys to understanding the traumatized child (Wingo, Aliza, Ressler, Bradley (2014).

According to DePrince and Freyd (2002), trauma can be caused by a wide variety of events, but there are

a few common aspects in these events that bring about trauma. There is frequently a violation of the person's core assumptions about the world and their human rights, putting the person in a state of extreme confusion and insecurity. This is seen when institutions depended upon for survival violate, humiliate, betray, or cause major losses or separations instead of evoking aspects like positive self-worth, safe boundaries and personal freedom.

Helpguide.Org. (2014) as cited by Wikipedia (2018), psychologically traumatic experiences can involve mental trauma and/or physical trauma that threatens one's well-being, sense of security, or survival. Typical causes and dangers of psychological trauma include: death of family member, lover, friend, teacher, or pet, witnessing a death, divorce, moving to a new location, harassment, embarrassment, abandonment, abusive relationships, rejection, co-dependence, physical assault, sexual abuse, partner battery, employment discrimination, police brutality, judicial corruption and misconduct, bullying, paternalism, domestic violence, indoctrination, being the victim of an alcoholic parent, the threat or the witnessing of violence (particularly in childhood), serious illness or injury, life-threatening medical conditions, and medication-induced trauma. Catastrophic natural disasters such as earthquakes and volcanic eruptions, large scale transportation accidents, house or domestic fire, motor vehicle accident, mass interpersonal violence like war, terrorist attacks or other mass victimization like sex trafficking, being taken as a hostage or being kidnapped can also cause psychological trauma. Long-term exposure to situations such as extreme poverty or other forms of abuse, such as verbal abuse, exist independently of physical trauma but still generate psychological trauma.

### **THEORETICAL BASES FOR TRAUMA/STRESS (SIGMUND FREUD PSYCHOANALYSIS THEORY)**

Understanding the concept of trauma from the theoretical stand point is crucial. Brett as cited by John, Wilson and Beverley (1993) believes that the three fundamental conceptualizations of trauma which still has wide recognition stems from Sigmund Freud psychoanalysis theory. They are: the traditional psychoanalytic model of symptom formation, stimulus-barrier definition of trauma, and repetition and defense model of trauma based on the operation of the repetition compulsion.

Freud holds that symptoms are formed when current frustrations revive infantile conflict. Under the impact of the later frustration, a regression occurs to the point of fixation of the original conflict. In this manner, the current symptoms come to reflect ways of feeling and defending that were operative at much earlier times. The conflict, if experienced consciously by the individual, would have proven traumatic, that is, overwhelmingly dangerous or extremely anxiety provoking. Hence

defenses are used to encapsulate the conflictual material, and a fixation occurs preventing normal development of the impulses involved in the conflict. In order for symptoms to form, the combined intensity of the current frustration and the infantile conflicts must be sufficiently great. The severity of the current frustration and infantile conflicts form a "complemental series": If one is high, the other one need only be low (Freud, 1917/1953).

There are however several limitations to this model: (1) there is minimal focus on the nature or severity of the stressor except as a stimulant to the revival of early conflict, (2) pathogenesis is accounted for by early infantile conflict.

The second psychoanalytic formulation of trauma is that it occurs when the intensity of stimuli becomes so great that the stimulus barrier is overwhelmed. The organism is then flooded with unmanageable impulses and its functioning is disrupted. This definition is useful because it emphasizes the intensity of a stressor. It is limited in that it does not address the question of whether there are differences between an infantile and adult trauma nor does it answer the question about whether there are any differences between the experience of a trauma that occurs as a result of infantile conflict or as a result of a catastrophic stressor.

The third psychoanalytic formulation of trauma is Freud's repetition and defense model based on the operation of the principle of repetition compulsion. Following the overwhelming assault on the stimulus barrier, a regression occurs, leading to the use of an early and primitive defense, the repetition compulsion. This defense consists in repeating a disturbing event in an effort to master it. By actively recreating the event, rather than passively experiencing it as in the original situation, the individual is given an opportunity to re-experience it with a higher degree of preparedness and efficacy in preventing the ego from being overwhelmed.

According to Varnada, (2017), applying Sigmund Freud in our current situation we discover that a major drive for people is the reduction of tension and the major cause of tension is anxiety. He identified three types of anxiety; reality anxiety, neurotic anxiety, and moral anxiety. Reality anxiety is the most basic form of anxiety and is based on the ego. It is typically based on the fear of real and possible events. Neurotic anxiety comes from an unconscious fear that the basic impulses of the id will take control of the person, leading to eventual punishment from expressing the ids desires. Moral anxiety comes from the superego. It appears in the form of a fear of violating values or moral codes, and appears as feelings like guilt or shame.

When anxiety occurs, the mind's first response is to seek rational ways of escaping the situation by increasing problem solving efforts and a range of defense mechanisms may be triggered. These are ways that the ego develops to help deal with the id and the superego. Defense mechanisms often appear unconsciously and tend to distort or falsify reality. When the distortion of reality occurs, there is a change in

perception which allows for a lessening in anxiety resulting in a reduction of tension one experiences. Freud noted a number of ego defense mechanisms are as follows:

- Denial: believing that what is true is actually false
- Displacement: taking out impulses on a less threatening target
- Intellectualization: avoiding unacceptable emotions by focusing on the intellectual aspects
- Projection: attributing uncomfortable feelings to others
- Rationalization: creating false but believable justifications
- Reaction Formation: taking the opposite belief because the true belief causes anxiety
- Regression: going back to a previous stage of development
- Repression: pushing uncomfortable thoughts out of conscious awareness
- Suppression: consciously forcing unwanted thoughts out of our awareness
- Sublimation: redirecting 'wrong' urges into socially acceptable actions.

These defenses are not under our conscious control and our unconscious will use one or more to protect one's self from stressful situations. They are natural and normal and without these, neurosis develops such as anxiety states, phobias, obsessions, or hysteria. All these impact the brain negatively.

According to Briere, John; Scott, & Catherine (2006), believes that stress has a significant effect on health. It can affect the onset of, or susceptibility to disease such as cancer, diabetes, obesity, and alcohol and substance abuse. In addition, developmental abnormalities and neuro-degeneration can occur due to an overload of stress. This is particularly relevant to children under chronic stress. They point out that the symptoms of stress can be physical (fatigue, headache, nausea, indigestion, breathlessness, skin rashes, chest pains and cramps), cognition (poor concentration, memory difficulties, confusion, demotivation and loss of sense of humor), emotional (anxiety, depression, fear, anger and irritability), and/or behavioral (unsociable, poor time management, increase in appetite, smoking, drinking, swearing, and yelling).

## THE STATEMENT OF THE PROBLEM

The Cameroonian society has changed greatly in the last few decades, most especially due to technological explosion. Expectations are greater, ambitions are higher and there is pressure to perform in all aspects of life. Information availability (e.g through cellphones, emails, instant messaging), greater financial constraints due to increased cost of living, unrealistic and unattainable expectations held up by individuals in the society modeled by inflated images of celebrities that are

perpetuated by the media, political pressure, domestic and national violence has doubled the number of persons with psychological and emotional problems in our community. Most often many people add to the multiple sources of pressure (external and internal) by thinking about what they ought to be doing and what they are actually doing in live.

It is worth noting that stress can affect anyone, even children. For example, separation from parents is the greatest cause of anxiety in our society today. Looking at the state of things in Cameroon most families are separated from each other. Very few parents are financially viable to stay at home with their children, as such they send their children to crèches and day-cares from an early age, some parents are forced to send their children to stay with relations for the purpose of schooling, and safety all these has brought great pressure on the people.

Many professionals feel that a number of children are too busy and do not have time to play creatively or relax after school. Children who begin to complain about the number of activities they are involved in or refuse to go to activities may be signaling to parents that they are too busy. It's a good idea for parents to talk with their children about how they are feeling about after-school activities unfortunately most parents are not available to do that.

External sources of pressure on children intensify their stress levels which subsequently affects their brain development. Parents need to be careful how they discuss issues (e.g. when talking about troubles at work, worrying about a relative's illness, or fighting with a spouse about financial matters) when their children are around because children will pick up on their parents' anxieties and begin to worry themselves.

The same could be said for exposure to sensitive news events. Children who watch replays of the disturbing images on TV or hear talk of civil unrest, and terrorism may worry about their own safety and that of the people they love. Talk to your child about what he or she sees and hears and monitor what he or she watches on TV can help him or her understand what's going on. Also, consider that complicating factors, such as an illness, death of a loved one, or a divorce, may be causing your child's stress. When these factors are added to the everyday pressures kids face, the stress is magnified.

## HOW THE BRAIN DEVELOPS

Brain development, is actually the process of creating, strengthening, and discarding connections among the neurons; these connections are called synapses. Synapses organize the brain by forming pathways that connect the parts of the brain governing everything we do from breathing and sleeping to thinking and feeling. It is worth noting that at birth, very few synapses have been formed. The synapses present at birth are primarily those that govern our bodily functions such as heart rate,

breathing, eating, and sleeping (Child Welfare information gateway 2015).

Myelination is a crucial stage in brain development that we must not leave untouched. Myelin is the white fatty tissue that ensures the transmission of neurotransmitters across synapses it forms a sheath to insulate mature brain cells. Myelination begins in the primary motor and sensory areas (the brain stem and cortex) and gradually progresses to the higher-order regions that control thought, memories, and feelings. A child's experiences affect the rate and growth of myelination, which continues into young adulthood (Shonkoff & Phillips, 2000).

The brain begins from the nerve cell, called neuron. During fetal development, neurons are created and migrate to form the various parts of the brain. As neurons migrate, they also differentiate, or specialize, to govern specific functions in the body in response to chemical signals (Perry, 2002). This process of development occurs sequentially from the "bottom up," that is, from areas of the brain controlling the most primitive functions of the body (e.g., heart rate, breathing) to the most sophisticated functions (e.g., complex thought) (Child Welfare information gateway 2015).

The first areas of the brain to fully develop are the brainstem and midbrain; they govern the autonomic functions which are the bodily functions necessary for life.

At birth, these lower portions of the nervous system are very well developed, whereas the higher regions (the limbic system and cerebral cortex) are still rather primitive. Higher function brain regions involved in regulating emotions, language, and abstract thought grow rapidly in the first 3 years of life. The growth in each region of the brain largely depends on receiving stimulation, which spurs activity in that region (Perry, 2006). This stimulation provides the foundation for learning. Reasons why we say our environment plays a great role on our brain development.

Right before puberty, adolescent brains experience a growth spurt that occurs mainly in the frontal lobe, which is the area that governs planning, impulse control, and reasoning. During the teenage years, the brain goes through a process of pruning synapses somewhat like the infant and toddler brain and also sees an increase in white matter and changes to neurotransmitter systems (Konrad, Firk, & Uhlhaas, 2013).

As the teenager grows into young adulthood, the brain develops more myelin to insulate the nerve fibers and speed neural processing, and this myelination occurs last in the frontal lobe. Normal puberty and adolescence lead to the maturation of a physical body, but the brain lags behind in development, especially in the areas that allow teenagers to reason and think logically. Most teenagers act impulsively at times, using a lower area of their brains their "gut reaction" because their frontal lobes are not yet mature. Impulsive behavior, poor decisions, and increased risk-taking are

all part of the normal teenage experience. Another change that happens during adolescence is the growth and transformation of the limbic system, which is responsible for our emotions. Teenagers may rely on their more primitive limbic system in interpreting emotions and reacting since they lack the more mature cortex that can override the limbic response (Chamberlain, 2009).

The extent to which the brain changes in response to repeated stimulation is known as Plasticity and this is dependent on the stage of development and the particular brain system or region affected by the stimulation (Perry, 2006). For instance, the lower parts of the brain, which control basic functions such as breathing and heart rate, are less flexible, or plastic, than the higher functioning cortex, which controls thoughts and feelings. While cortex plasticity decreases as a child gets older, some degree of plasticity remains. In fact, the brain plasticity is what allows the individual to keep learning into adulthood and throughout life. The developing brain's ongoing adaptations are the result of both genetics and experience. Our brains prepare us to expect certain experiences by forming the pathways needed to respond to those experiences.

The ability to adapt to our environment is a part of normal development. Children growing up in cold climates, on rural farms, or in large sibling groups learn how to function in those environments. Regardless of the general environment, though, all children need stimulation and nurturance for healthy development. If these are lacking (e.g., if a child's caretakers are indifferent, hostile, depressed, or cognitively impaired), the child's brain development may be impaired. Because the brain adapts to its environment, it will adapt to a negative environment just as readily as it will adapt to a positive one.

### **Sensitive Periods in brain development**

Researchers believe that there are sensitive periods for development of certain capabilities. These refer to windows of time in the developmental process when certain parts of the brain may be most susceptible to particular experiences.

It is worth noting that if certain synapses and neuronal pathways are not repeatedly activated, they may be discarded, and their capabilities may diminish. For example, infants have a genetic predisposition to form strong attachments to their primary caregivers, but they may not be able to achieve strong attachments, or durable bonds if they are in a severely neglectful situation with little one-on-one caregiver contact. This indicates that there is a sensitive period for attachment, but it is likely that there is a general sensitive period rather than a true cut-off point for recovery (Zeanah, Gunnar, McCall, Kreppner, & Fox, 2011).

While sensitive periods exist for development and learning, we also know that the plasticity of the brain often allows children to recover from missing certain experiences. Both children and adults may be able to

make up for missed experiences later in life, but it is likely to be more difficult. This is especially true if a young child was deprived of certain stimulation, which resulted in the pruning of synapses (neuronal connections) relevant to that stimulation and the loss of neuronal pathways. As children progress through each developmental stage, they will learn and master each step more easily if their brains have built an efficient network of pathways to support optimal functioning.

The organizing framework for children's development is based on the creation of memories. When repeated experiences strengthen a neuronal pathway, the pathway becomes encoded, and it eventually becomes a memory. Children learn words to express themselves. And they learn that a smile usually brings a smile in return. At some point, they no longer have to think much about these processes their brains manage these experiences with little effort because the memories that have been created allow for a smooth, efficient flow of information.

The creation of memories is part of our adaptation to our environment. Our brains attempt to understand the world around us and fashion our interactions with that world in a way that promotes our survival and, hopefully, our growth, but if the early environment is abusive or neglectful, our brains may create memories of these experiences that adversely color our view of the world throughout our life.

Babies are born with the capacity for implicit memory, which means that they can perceive their environment and recall it in certain unconscious ways (Applegate & Shapiro, 2005). For instance, they recognize their mother's voice from an unconscious memory. These early implicit memories may have a significant impact on a child's subsequent attachment relationships.

In contrast, explicit memory, which develops around age 2, allows children to talk about themselves in the past and future or in different places or circumstances through the process of conscious recollection (Applegate & Shapiro, 2005). Sometimes, children who have been abused or suffered other trauma may not retain or be able to access explicit memories of their experiences; however, they may retain implicit memories of the physical or emotional sensations, and these implicit memories may produce flashbacks, nightmares, or other uncontrollable reactions (Applegate & Shapiro, 2005).

#### **EFFECTS OF TRAUMA/STRESS ON BRAIN DEVELOPMENT (TRAUMATIC OCCURRENCES AS A TRAJECTORY FOR BOTH STRUCTURAL AND FUNCTIONAL BRAIN DISORDERS)**

Just as positive experiences can assist with healthy brain development, children's experiences with child maltreatment or other forms of toxic stress, such as domestic violence or disasters, war, environmental hazards and more can negatively affect brain

development. This includes changes to the structure and chemical activity of the brain (e.g., decreased size or connectivity in some parts of the brain) and in the emotional and behavioral functioning of the child (e.g., over-sensitivity to stressful situations). We all know that healthy brain development includes situations in which babies' babbles, gestures, or cries bring reliable, appropriate reactions from their caregivers. These caregiver-child interactions strengthen babies' neuronal pathways regarding social interactions and how to get their needs met, both physically and emotionally. If children live in a chaotic or threatening world, one in which their caregivers respond with abuse or chronically provide no response, their brains may become hyper alert for danger or not fully develop. These neuronal pathways that are developed and strengthened under negative conditions prepare children to cope in that negative environment, and their ability to respond to nurturing and kindness may be impaired (Shonkoff & Phillips, 2000).

The specific effects of maltreatment may depend on such factors as the age of the child at the time of the maltreatment, whether the maltreatment was a one-time incident or chronic, the identity of the abuser (e.g., parent or other adult), whether the child had a dependable nurturing individual in his or her life, the type and severity of the maltreatment, the intervention, how long the maltreatment lasted, and other individual and environmental characteristics Briere, John; Scott, and Catherine (2006).

McCrory, De Brito, and Viding, (2010); Wilson, Hansen, and Li, (2011) holds that, adults who were maltreated may have reduced volume in the hippocampus, which is central to learning and memory. Toxic stress also can reduce the hippocampus's capacity to bring cortisol levels back to normal after a stressful event has occurred.

Shonkoff, (2012) states that maltreated children and adolescents tend to have decreased volume in the corpus callosum, which is the largest white matter structure in the brain and is responsible for interhemispheric communication and other processes (e.g., arousal, emotion, higher cognitive abilities). McCrory, De Brito, and Viding, (2010) believes that Maltreated children and adolescents tend to have decreased volume in the cerebellum, which helps coordinate motor behavior and executive functioning.

The National Scientific Council on the Developing Child, (2012) conducted an experimental study on adolescents and adults who were severely neglected as children the result showed that they had smaller prefrontal cortex, which is critical to behavioral, cognition, and emotional regulation this finding contradicted those of McCrory, De Brito, & Viding, (2010) which showed that there wasn't any differences. Physically abused children also have reduced volume in the orbitofrontal cortex, a part of the prefrontal cortex that is central to emotion and social regulation (Hanson et al., 2010).

Although most studies have found that amygdala volume is not affected by maltreatment, abuse and neglect can cause over activity in that area of the brain, which helps determine whether a stimulus is threatening and trigger emotional responses (National Scientific Council on the Developing Child, 2010b; Shonkoff, 2012).

Many maltreated children, both in institutional and family settings, and especially those who experienced severe neglect, tend to have lower than normal morning cortisol levels coupled with flatter release levels throughout the day (Bruce, Fisher, Pears, & Levine, 2009; National Scientific Council on the Developing Child, 2012). Typically, children have a sharp increase in cortisol in the morning followed by a steady decrease throughout the day. On the other hand, children in foster care who experienced severe emotional maltreatment had higher than normal morning cortisol levels. These results may be due to the body reacting differently to different stressors. Abnormal cortisol levels can have many negative effects. Lower cortisol levels can lead to decreased energy resources, which could affect learning and socialization; externalizing disorders; and increased vulnerability to autoimmune disorders (Bruce, Fisher, Pears, & Levine, 2009). Higher cortisol levels could harm cognitive processes, subdue immune and inflammatory reactions, or heighten the risk for affective disorders.

Children who experienced severe neglect early in life while in institutional settings often have decreased electrical activity in their brains, decreased brain metabolism, and poorer connections between areas of the brain that are key to integrating complex information (National Scientific Council on the Developing Child, 2012). These children also may continue to have abnormal patterns of adrenaline activity years after being adopted from institutional settings.

Additionally, malnutrition, a form of neglect, can impair both brain development (e.g., slowing the growth of neurons, axons, and synapses) and function (e.g., neurotransmitter syntheses, the maintenance of brain tissue) (Prado & Dewey, 2012).

We also know that some cases of physical abuse can cause immediate direct structural damage to a child's brain. For example, according to the National Center on Shaken Baby Syndrome, shaking a child can destroy brain tissue and tear blood vessels. In the short term, this can lead to seizures, loss of consciousness, or even death. In the long-term, shaking can damage the fragile brain so that a child develops a range of sensory impairments, as well as cognitive, learning, and behavioral disabilities. Other types of head injuries caused by physical abuse can have similar effects (Hansen, & Li, 2011).

Changes in brain structure and chemical activity caused by child maltreatment can have a wide variety of effects on children's behavioral, social, and emotional functioning. Persistent Fear Response. Chronic stress or repeated trauma can result in a number of biological reactions, including a persistent fear state (National Scientific Council on the Developing Child, 2010b).

Chronic activation of the neuronal pathways involved in the fear response can create permanent memories that shape the child's perception of and response to the environment. While this adaptation may be necessary for survival in a hostile world, it can become a way of life that is difficult to change, even if the environment improves.

Children with a persistent fear response may lose their ability to differentiate between danger and safety, and they may identify a threat in a nonthreatening situation (National Scientific Council on the Developing Child, 2010b). For example, a child who has been maltreated may associate the fear caused by a specific person or place with similar people or places that pose no threat. This generalized fear response may be the foundation of future anxiety disorders, (National Scientific Council on the Developing Child, 2010b).

When children are exposed to chronic, traumatic stress, their brains sensitize the pathways for the fear response and create memories that automatically trigger that response without conscious thought. This is called hyper-arousal. These children may be highly sensitive to nonverbal cues, such as eye contact or a touch on the arm, and they may be more likely to misinterpret them (National Scientific Council on the Developing Child, 2010b). Consumed with a need to monitor nonverbal cues for threats, their brains are less able to interpret and respond to verbal cues, even when they are in an environment typically considered nonthreatening. While these children are often labeled as learning disabled, the reality is that their brains have developed so that they are constantly on alert and are unable to achieve the relative calm necessary for learning (Child Trauma Academy, n.d.).

Child maltreatment can lead to structural and chemical changes in the areas of the brain involved in emotion and stress regulation (National Scientific Council on the Developing Child, 2010b). For example, maltreatment can affect connectivity between the amygdala and hippocampus, which can then initiate the development of anxiety and depression by late adolescence (Herrington et al., 2013). Additionally, early emotional abuse or severe deprivation may permanently alter the brain's ability to use serotonin, a neurotransmitter that helps produce feelings of well-being and emotional stability (Healy, 2004).

Executive functioning generally includes three components: working memory (being able to keep and use information over a short period of time), inhibitory control (filtering thoughts and impulses), and cognitive or mental flexibility (adjusting to changed demands, priorities, or perspectives). The structural and neurochemical damage caused by maltreatment can create deficits in all areas of executive functioning, even at an early age (Hostinar, Stellern, Schaefer, Carlson, & Gunnar, 2012; National Scientific Council on the Developing Child, 2011). Executive functioning skills help people achieve academic and career success, bolster social interactions, and assist in everyday activities. The brain alterations caused by a toxic stress

response can result in lower academic achievement, intellectual impairment, decreased IQ, and weakened ability to maintain attention (Wilson, 2011).

Although neglect often is thought of as a failure to meet a child's physical needs for food, shelter, and safety, neglect also can be a failure to meet a child's cognitive, emotional, or social needs. For children to master developmental tasks in these areas, they need opportunities and encouragement from their caregivers. If this stimulation is lacking during children's early years, the weak neuronal pathways that developed in expectation of these experiences may wither and die, and the children may not achieve the usual developmental milestones. Neglected children often do not show the rapid growth that normally occurs in language development at 18–24 months. These types of delays may extend to all types of normal development for neglected children, including their cognitive-behavioral, socio-emotional, and physical development (Scannapieco, 2008).

**Complicated Social Interactions:** Toxic stress can alter brain development in ways that make interaction with others more difficult. Children or youth with toxic stress may find it more challenging to navigate social situations and adapt to changing social contexts (Hanson et al., 2010). They may perceive threats in safe situations more frequently and react accordingly, and they may have more difficulty interacting with others (National Scientific Council on the Developing Child, 2010b). For example, a maltreated child may misinterpret a peer's neutral facial expression as anger, which may cause the maltreated child to become aggressive or overly defensive toward the peer. They may become less responsive to positive stimuli than non-maltreated children.

## IMPLICATIONS FOR PRACTICE AND POLICY

With this information we are better able to understand what is happening within the brains of children who are experiencing traumatic situations like most children and people in Cameroon. We also now know that children who were reared in severely stressful environments can see positive effects on brain development and functioning when their living environments improve (Sheridan, Fox, Zeanah, McLaughlin, & Nelson, 2012). We can use this information to improve our systems of care and to strengthen our prevention efforts.

A number of trends in child welfare may help provide a more caring view of the world to a traumatized child. These trends include:

Trauma-informed care Family-centered practice and case planning, including parent-child interaction therapy, Individualized services for children and families, the growth of child advocacy centers, where children can be interviewed and assessed and receive services in a child-friendly environment.

The promotion of evidence-based practice Prevention. Child welfare systems that devote significant efforts to prevention may be the most successful in helping children and families and promoting healthy brain development. Prevention efforts should focus on supporting and strengthening children's families and building on the family's positive attributes so that children have the best chance of remaining safely in their homes and communities while receiving proper nurturing and care. These efforts may target the general population by educating the public and changing policies to promote healthy brain and families considered to be at-risk of developing problems.

Intensive, early intervention when the brain is most plastic is much more effective than reactive services as the child ages (Perry, 2009). The development of referral procedures for children who are involved in toxic stress conditions to psychologist and other personnel for appropriate intervention. Community education programs also serve as a prevention method that can promote protective factors and lead to positive outcomes for both parents and children.

One theory about healing a damaged or altered brain is that the interventions must target those portions of the brain that have been altered (Perry, 2000b). Because brain functioning is altered by repeated experiences that strengthen and sensitize neuronal pathways, interventions should address the totality of the child's life, providing frequent, consistent replacement experiences so that the child's brain can begin to incorporate a new environment one that is safe, predictable, and nurturing.

It is however worthy of note that children's recovery depends on a variety of factors, including the timing, severity, and duration of the maltreatment or other toxic stress, the intervention itself, and the individual child's response to the maltreatment (National Scientific Council on the Developing Child, 2012). In some cases, doctors may prescribe psychotropic medications for certain mental health conditions, such as depression or anxiety.

It is important for us to have realistic expectations for our children. Children who have been traumatized may not be functioning at their chronological age in terms of their physical, social, emotional, and cognitive skills. They may also be displaying unusual and/or difficult coping behaviors. For example, abused or neglected children may:

1. Be unable to control their emotions and have frequent outbursts
2. Have difficulties learning in school
3. Have difficulties getting along with siblings or classmates
4. Have unusual eating or sleeping behaviors
5. Attempt to provoke fights or solicit sexual experiences
6. Be socially or emotionally inappropriate for their age
7. Be unresponsive to affection

Understanding some basic information about the neurobiology underlying many challenging behaviors may help us shape our responses more effectively.

In general, children who have been traumatized need nurturance, stability, predictability, understanding, and support (Committee on Early Childhood, Adoption and Dependent Care, 2000). They may need frequent, repeated experiences of these kinds to begin altering their view of the world from one that is uncaring or hostile to one that is caring and supportive. Until that view begins to take hold in a child's mind, the child may not be able to engage in a truly positive relationship, and the longer a child live in a traumatized environment, the harder it will be to convince the child's brain that the world can change. Consistent nurturing from well trained and supported personnel may offer the best hope for the children who need it most.

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