Maltreatment and Its Effects on Early Brain Development

“This is an exciting time to be studying the brain” (Applegate & Shapiro, 2005, p. 1). New technologies have made it possible to explore the biological basis of mental phenomena such as emotion and memory. Scientists are studying how the brain develops in the context of interpersonal relationships and how caretaking influences brain functions.

Recent advances in neurobiology may help explain the often-noted “cycle of violence.” Clinicians have known for many years that some seriously abused children will “repeat the cycle” when they become adults and maltreat their own children. The cycle is sometimes attributed to “learning” but preliminary research findings suggest that the reasons are more complex. A group of researchers have hypothesized that stress, whether in the form of physical abuse, emotional abuse, or sexual trauma or through exposure to warfare, famine, or pestilence, can trigger hormonal changes that can alter a child’s brain (Teicher, 2002).

The physical connections between neurons formed in childhood are not “hard-wired” or unchangeable. Instead, brain development is an ongoing process. The connections between neurons guide our behavior and at the same time, new thoughts and actions continue to change the pattern of connectivity between the neurons. The greater the activity that occurs between assemblies of neurons, the stronger the connections become. Thus, “experiences can change the function of our brains and even alter its structure” (Stien & Kendall, 2004, p. 3).

Genetics do predispose us to act in certain ways. However, in most instances neither genes alone or early experiences alone determine personality and functioning of the child. Rather, interplay between “nature” and “nurture” determines the landscape of the brain. Genes and early experiences become “partners in a very complex dance” (Stien & Kendall, 2004, p. 2).

In rare cases (for example, Huntington’s chorea and PKU), a single gene does determine whether or not an individual develops a disorder. However, it is more usual that a gene can predispose an individual to a disease (for example, Type II diabetes) with lifestyle (diet, exercise) being the determining factors as to whether or not the disease is manifest. Thus, in most instances genes have an indirect effect because the environment can modify genes.

Stress during childhood (such as maltreatment) may trigger the expression of genes that might otherwise have remained dormant. Negative experiences of abuse or neglect induce a cascade of chemical and hormonal changes in the brain that impede development and integration of various brain systems. Conversely, positive experiences and parent nurturing can strengthen healthy neural connections and promote learning (Stien & Kendall, 2004).

Secure attachment and adequate nurturing produce a growth-facilitating environment that builds neural connections, integrates brain systems, and strengthens the infant’s capacity to cope with stress. Abuse and neglect induce chaotic biochemical changes that interfere with the maturation of the brain’s coping systems, leading to problems with emotional regulation, relationships, and identity formation (Schore, 2001, cited in Stien & Kendall, 2004).

This article will help the reader understand normal brain development and how that differs from brain development when there is maltreatment. The results of trauma, neglect, and chronic arousal will be discussed. The article will review what is known about both short-term and longer-lasting effects. Finally, the article will discuss what foster parents and clinicians can do to try to remedy the negative effects of early maltreatment.

A Brief Overview of Brain Development

The human brain is a complex and dynamic organ that allows us to understand and adapt to the complex environments that we inhabit. The brain directs almost all of our functioning from automatic processes such as respiration to very complex ones such as solving difficult math problems.

In general, the brain can be divided into two types of cells or matter: grey and white. Grey matter consists of capillary blood vessels and neurons, which are grey-brown in appearance (Kolb & Whishaw, 1996). The neuron is the basic unit of the nervous system and it is able to receive, process, and transmit information (Teeter & Semrud-Clikeman, 1997). When babies are born, they have almost all of the neurons they will ever have, more than 100 million of them! (Shonkoff & Phillips, 2000). However, neurons are not static, hard-wired processors of information like the microprocessors that enable computers to function. Rather, neurons are influenced by and adapt to the changing environment that the brain encounters. In a manner of speaking, neurons are modified by experience; they learn, remember, and forget (Hinton, 1993).

The different experiences that a child encounters will contribute to the formation...
of neural circuits or groups of neurons that communicate with each other. Consequently, the environment that the developing brain is exposed to will impact the development and function of the neural circuitry that is responsible for a number of cognitive and behavioral functions. These functions include memory, learning, emotional regulation, and planning responses to environmental events. The growth in each region of the brain largely depends upon the infant receiving stimulation which spurs activity in that region. This stimulation provides the foundation for learning and failure to receive stimulation will lead to deficits (National Clearinghouse, 2001).

The impact of the environment on the developing brain will be discussed more thoroughly later in this article. For now, we will focus on the basic cellular units of the brain that give it its functional capabilities: the neuron and neuroglia.

### Basic Cellular Units

In general, each neuron is composed of a cell body, an axon, and dendrites. The cell body is a semi-permeable membrane that encapsulates structures called organelles. The organelles include the nucleus, which contains the neuron’s DNA and thus the genetic instructions that serve as a blueprint for the neuron’s structure and function (Lambert & Kinsley, 2005). Another organelle is the mitochondria, which is the energy center for the neuron. The mitochondria are the center of cellular metabolism, where fats, sugars, and proteins are metabolized from food react with oxygen to produce a substance called adenosine triphosphate (ATP) (Lambert & Kinsley, 2005). ATP is the fuel that provides the energy the neuron needs to perform its activities.

The next major structure of the neuron is the axon. The axon is a long, cylindrical, string-like fiber that projects from the cell body. The primary function of the axon is to transmit neural impulses to other neurons through a complex electrochemical process called neurotransmission. Neurotransmission enables rapid communication throughout the brain and body and this communication facilitates the execution of relatively simple functions such as walking to more complex ones including problem solving.

When a neural impulse travels down the axon, it will reach the terminal buttons, which are essentially containers at the tip of the axon that store chemicals called neurotransmitters. The neural impulse causes the terminal buttons to release neurotransmitters into a microscopic gap between neurons. The neurotransmitters cross this gap and interact with the next neuron in the chain. In general, neurotransmitters have one of two basic functions; excite the next neuron in the circuit causing it to fire and send another neural impulse down the line or inhibit the next neuron in the chain from firing.

Axons are typically covered in a myelin sheath, which is comprised of lipids and proteins and appears white. The myelin sheath provides insulation for the axon, similar to how a rubber coating insulates an electrical wire. The insulation provided by the myelin sheath speeds the neural impulses, increasing their efficiency. The importance of the myelin sheath with respect to the relationship between brain functioning and human behavior is illustrated by the potentially devastating effects of diseases such as Multiple Sclerosis (MS). In MS, the myelin sheath degenerates, interrupting neurotransmission. This may result in symptoms impacting several areas of functioning including cognitive (e.g., forgetfulness), sensory (e.g., vision loss), and motor (e.g., paralysis). Similarly, shaking a baby (SBS or “Shaken Baby Syndrome”) can have devastating consequences for brain functioning as this can cause widespread injury to the brain including damage to the white matter. (Readers can refer to the block, this issue and those interested in details about shaken baby syndrome can request VCPN volumes 32 and 58.)

The last major neuronal structure that will be discussed is the dendrite. Dendrites are extensions of the cell body that receive information from other cells (Kolb & Whishaw, 1996). Each neuron may have a few dendrites to greater than twenty and each dendrite may have thousands of tiny hair-like projections called dendritic spines. Dendrites and their spines greatly increase the surface area of the neuron, providing it with the ability to form tens of thousands of connections with other neurons (Lambert & Kinsley, 2005). This results in an exponential increase in the amount and complexity of information that can be received by a particular neuron and greatly enhances communication amongst groups of neurons.

The next time you look at a tree, think of the trunk as the cell body, the branches as the dendrites and the leaves as the dendritic spines. As the tree grows, so does the number of branches and leaves. This allows the surface area of the tree to expand well beyond the limits of its trunk permitting the tree to absorb greater amounts of sunlight. This is similar to the branching out of neurons, which allows the child’s brain to collect greater amounts of information.

The brain has been described as functioning on the “use it or lose it” principle. Parents who can soothe and engage a child and provide interesting games, reading, and experiences appropriate to the child’s developmental level are hypothesized to foster a lush expansive arborization of dendrites and dendritic spines.

### White Matter

The neuron would not be able to perform its complex functions if it were not for a group of cells called neuroglia (i.e., nerve glue). Neuroglia is comprised of a fatty substance called lipids and proteins, which gives them a white appearance. This is the reason they are referred to as the brain’s white matter (Kolb & Whishaw, 1996; Lambert & Kinsley, 2005). Neuroglia outnumber neurons by a ratio of about 50:1 (Kandel et al., 2000 in Lambert & Kinsley, 2005) and provide a number of supportive and maintenance activities for the neuron including: 1) structural support; 2) nutrition; 3) insulation of axons and synapses; 4) facilitation of transmission of signals across neurons; 5) repairing damaged neurons and removing waste products, and; 6) filling voids in brain tissue created by damage. In addition, a type of neuroglial cell called astrocytes helps create the blood-brain barrier, which separates the blood supply from brain tissue (Kalat, 1996). The blood-brain barrier keeps harmful substances such as blood-borne pathogens from entering the brain while allowing the entry of substances like oxygen and glucose that provide nourishment (Lambert & Kinsley, 2005). Malnutrition can compromise this process, and would impact overall brain growth.
Prenatal Brain Development

Shortly following fertilization of the egg, neurons begin to form through mitosis in the ventricular or inner lining of the developing brain (Kolb & Whishaw, 1996). The brain develops rapidly during the prenatal stage when approximately 250,000 nerve cells are formed each minute by mitosis (Papalia & Olds, 1992). This stage of brain development is largely controlled by genetic factors.

Neurons begin to form connections with each other through a process called synaptogenesis. Synaptogenesis occurs when large numbers of neurons form synapses with one another resulting in the formation of neural circuits. Synaptogenesis is a very complex and dynamic process as the human brain contains approximately 100 billion neurons (William & Herrup, 1988) and each neuron is capable of forming tens of thousands of connections.

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Malnutrition, both in the prenatal period and during the first few years of life, has been shown to result in stunted brain growth and slower passage of electrical signals in the brain. These effects are linked to cognitive, social and behavioral deficits with possible long-term consequences (National Clearinghouse, 2001). For example, iron deficiency (the most common form of malnutrition in the U.S.) has been linked to cognitive and motor delays, anxiety, depression, social problems, and problems with attention (National Clearinghouse, 2001).

In summary, the brain develops rapidly during the prenatal period and many of the basic brain structures necessary to survive and adapt to the child’s ever-changing world are in place by birth. However, brain development during the prenatal period only sets the stage for later development. The brain’s neural circuitry will undergo massive changes as it absorbs, learns, and responds to the tremendous amount of environmental information that it will encounter following birth and throughout the lifespan.

Postnatal Brain Development

During the postnatal period of brain development (i.e. following birth), new neurons are produced and a massive number of new connections form between neurons (i.e. neural circuits or synapses). Synapses organize the brain by forming neural pathways that connect all parts of the brain governing...
Early Brain Development

continued from page 3

everything one does— including breathing and sleeping and thinking and feeling.

By birth, a relatively small number of synapses have been formed and these govern mainly bodily functions such as breathing, heart rate, sleeping and eating. Almost all other connections are developed as the baby grows. The development of these connections (or synapses) result from the brain receiving and processing large amounts of information through the senses. Thus, connections between neurons are formed as the child experiences various interactions with the environment including perceiving visual images, touching objects and listening to people speak. This is part of the “use it or lose it” process discussed earlier. The brain must be stimulated in order to develop properly.

The development of synapses proceeds at an astounding rate in the child’s early years. By the time children are 3 years old, their brains have approximately 1,000 trillion synapses, many more than they will need. Some are strengthened and remain intact and many are discarded. By teenage years, about half of the synapses have been discarded, leaving about 500 trillion which will remain for most of the rest of life.

There are two very important concepts to understand with respect to neural circuits or synapses. First, the formation of a particular neural circuit does not ensure its long-term survival. For the most part, the neural circuits that survive are those that continue to receive stimulation from the environment. These circuits underlie functions that allow the organism to adapt to its surroundings. Second, the neural circuitry that underlies our ability to think, reason, and understand our emotions is not static or “hardwired”. Conversely, neural circuits are malleable and their formation or modification is dependent on a large extent on environmental stimulation. This characteristic is termed “plasticity.” Plasticity may have healthy or adverse implications for the developing child depending on the type of environment to which the brain is exposed.

For example, in normal development, a baby cries and is attended to. When a baby’s cry brings food or attention and comfort, the baby strengthens the neuronal pathways that help her learn how to get needs met, both physically and emotionally. In contrast, babies whose cries are met with abuse or neglect learn other lessons. The neural pathways that are developed under these negative conditions prepare the baby to cope in a negative environment and the ability to respond to kindness and nurturing can become impaired (Shonkoff & Phillips, 2000). Schore (1997) contends that abuse, neglect, and chronic states of misattunement lead to “over-pruning” of synapses in the right orbitofrontal cortex, leaving the child with an impaired ability to modulate and regulate emotion (cited in Lott, 1998).

Frequent touching by caregivers is a biologic necessity for physical and psychological growth. Neglect is likely perceived by the infant as intense anxiety. The stress affects the limbic-hypothalamic-pituitary-adrenal (HPA) axis and other brain systems involved in responding to stress (De Bellis, 2005). Although all infants have a genetic predisposition to form strong attachments to their primary caregivers, if a baby’s caretakers are unresponsive or threatening and the attachment process is disrupted, then the ability to form healthy relationships can remain impaired throughout the lifetime (Perry, 2001). Maternal deprivation is associated with dysregulation of the developing stress response systems and with abnormal infant behaviors (De Bellis, 2005). As mentioned before, some hypothesize that the lack of caregiver response to a baby’s distress allows high levels of cortisol and other stress hormones to change brain development, reducing the number of synapses.

Therefore, children living in environments rich in stimulation are more likely to develop neural connections that are greater in number and complexity than children in environments with a minimal amount of stimulation. This has implications for cognitive development and the health and robustness of the brain over the lifespan. Neurons release “ trophic factors” (growth factors) which sustain other neurons. As neurons die over the life span through natural attrition, disease processes and injury, richly-connected neurons remain well-established by trophic factors. Poorly connected neurons tend to become more isolated and are less likely to survive.

For example, brain images of children from orphanages in Eastern Europe who were severely deprived of stimulation including nurturance and interaction with caregivers had brains that were significantly smaller compared to children the same age who were not maltreated (National Clearinghouse, 2001). The smaller brains of these children were characterized by fewer neuronal circuits or pathways (see graphic, page 11). As previously discussed, neuronal circuits are formed in part by stimulation from the environment and are the infrastructure needed to support various cognitive functions including memory, learning, and self-regulation.

The increase in brain size as the child grows into adulthood is due to the production of new neurons, the formation of new connections between neurons, and myelination. As previously discussed, myelination is the process by which a neuron’s axon is “sheathed” or insulated in a protective layer of lipids and proteins. This insulation allows for faster and more efficient communication between neurons. Increases in myelination appear to be correlated with the acquisition and development of visual, motor, cognitive and social skills. Myelination begins during prenatal development with the brain’s basic sensory-motor tracts. This is one of the reasons why a newborn is able to nurse immediately following birth. However, myelination occurs primarily during postnatal development and increases brain weight from 400 grams at birth to 1,410 grams by age 15 (Kolb & Whishaw, 1996).

The brain finishes myelinating during young adulthood with the prefrontal cortex. This brain region is generally located behind the eye sockets and lower region of the forehead and is responsible for several functions including planning, organization, abstract thinking, emotional regulation, and impulse control. The incomplete myelination of the prefrontal cortex during adolescence may explain the relatively higher degree of risk-taking behavior and emotionality occurring during adolescence.

The development of the corpus callosum (which controls information exchange between the two brain hemispheres) may be affected by maltreatment. A 2000 study by DeBellis & Keshavan (cited in DeBellis, 2005) found that maltreated children with PTSD (Post-Traumatic Stress Disorder) failed to show the normal age-related increases in the area of the total corpus callosum when compared to nonmaltreated participants. This finding indicated deficits in age-appropriate myelination in these traumatized children. The finding was more prominent for male children.

Teicher (2000) also found that parts of the corpus callosum were smaller in 15 maltreated children than in the control group. Neglected boys and sexually-abused girls showed the greatest effects. For the maltreated children, the right cortex showed greater development than the left cortex, even though all subjects

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were right-handed and hence left hemisphere dominant. The left hemisphere is primarily specialized for perceiving and expressing language while the right hemisphere is more specialized for processing spatial information and emotion (especially negative emotion).

At first glance, it is logical to assume that having an infinite number of neurons would enhance cognitive functioning. However, a stage of brain development called apoptosis suggests that this is not the case. Apoptosis is a normal, biologically-programmed cell death that eliminates redundant, unnecessary or inefficient neurons from the developing brain (Kalat, 1996). This results in a brain that is more efficient and adaptive. Without apoptosis, competing groups of neurons might interfere with each other as the brain attempts to respond to environmental demands. Following apoptosis, surviving neurons form new synaptic connections resulting in a more adaptive brain. Apoptosis is akin to eliminating unnecessary layers of bureaucracy in an organization. The result is a leaner organization that is likely to respond more efficiently, adaptively, and with greater flexibility to challenges that it may face.

Theoretically, for the maltreated child, the process of apoptosis could result in significant deficiencies. For example, in order to develop speech, the baby must be repeatedly exposed to interactive language within a certain time period, otherwise, some pathways developed in anticipation of speech development may be discarded and language may not develop as expected or may develop poorly. This is another example of the “use it or lose it” principle (Greenough, Black, & Wallace, 1987).

Sensitive Time Periods

A sensitive time period is a specific time window during which specific experiences are obligatory for normal brain development (Shonkoff & Phillips, 2000). There is evidence that there may be certain time periods for the development of some capabilities. For example, alcohol exposure in utero early in gestation has differing effects on the developing brain than alcohol exposure later in the pregnancy. Likewise, nutrient deficiency shows differing effects depending upon its timing.

Language learning is a good example of experience-dependent neural development. When 3 months old, an infant can distinguish different sounds, many more than are present in any one spoken language. Over the next several months, the brain will organize more efficiently so that it only requires those sounds which are part of the language the child normally hears. During early childhood the brain retains the ability to re-learn sounds it has discarded. After about age 10, however, plasticity for this function is lost (Hawley, 1998).

As children progress through each developmental stage, they will learn and master tasks (emotional, social, and cognitive) more easily if their brains have built an efficient network of pathways (Helgeson, 1997). While synapses are being formed at an intense pace, opportunities for learning seem almost limitless. However, after age 3 when the process of pruning synapses begins, the opportunities decrease (National Clearinghouse, 2001). Children still learn later in life, but not at the astounding rate that occurs earlier in development. Consequently, learning later in childhood is relatively more difficult. This fact of brain development explains why young children can learn to play a musical instrument or a second language much easier than older children or adults.

“It is much easier to influence the functioning of a developing system than to reorganize and alter the functioning of a developed system” (Perry, 2000, p. 11). This is why early intervention and prevention efforts are so vitally important.

The Impact of Psychological Trauma and Chronic Neglect on the Developing Brain

In normal development, brief periods of mild, predictable stress are not considered harmful. Indeed, exposure to stress may actually be helpful or even necessary in preparing the child to adapt to a stressful world. In maltreatment, however, stress is prolonged, severe, and/or unpredictable. The brain’s normal developmental processes can be literally altered resulting in negative impacts on the child’s physical growth, cognitive growth, emotional stability, and socialization (National Clearinghouse, 2001).

Chronic stress sensitizes neural pathways and over-develops certain regions of the brain involved in anxiety and fear responses. Meanwhile, other neural pathways and brain regions are under-developed. Children who experience serious and chronic physical or sexual abuse focus their brain’s energy on survival and responding to threats in the environment. Children who experience chronic neglect - remaining hungry, cold, scared or in pain - also focus their brain’s resources on survival. Deprivation and its effects on the brain will be discussed in more detail later.

Chronic Fear

Chronic stimulation of the brain’s fear response means that this area is frequently activated. Other regions, such as those continued on page 6
Hyperarousal

Chronic stress also can cause hyperalertness or hyperarousal. The child may believe his survival depends upon constant alertness. However, in order to maintain a state of alertness, other tasks and development are compromised. Behavior and feeling is directed by the more primitive brain processes (Perry, 2000). Thus, hypervigilant children may show well-developed nonverbal skills ("street smarts") in comparison to their verbal skills, over-read or misinterpret nonverbal cues, perceive eye contact as a threat, and interpret any touch as an antecedent to abuse or seduction. The child may be perceived as "bright" by teachers but be unable to succeed at academic tasks and be given the label "learning disabled" due to the disparity between verbal and nonverbal skills (Perry, 2001b).

The hyperaroused child remains alert to anticipatory cues of impending trouble such as critical comments, antagonistic facial expressions or awkward silences. Such "signals" trigger emotional stress-related reactions in the child. Even if presented with a better environment (such as foster care), the child does not have the neural pathways developed to respond to positive attention. Rather, the hypervigilant child is focused on and sensitized to negative affect. He or she watches for any small indication of conflict, then overreacts (Thompson & Calkins, 1996).

For any person, at the initial sign of threat, an "alarm reaction" occurs. This reaction causes increased activity of the sympathetic nervous system: increased heart rate, higher blood pressure, increased respiration, increased release of blood sugar, increased release of norepinephrine, and increased muscle tone. The brain functions adopt a state of hyper-vigilance, excluding all non-critical information (Perry et al., 1995).

Whenever a similar stressor reoccurs, the initial response is reactivated. Over time, the response generalizes. Thus, when the child is exposed to anything vaguely similar to past traumatic events, the hyper-arousal is triggered with heightened anxiety. Resulting behavioral problems can include hyperactivity, behavioral impulsivity, sleep problems, hypertension and a variety of neuroendocrine abnormalities. A resulting diagnosis of ADHD is possible, although a more accurate description would be posttraumatic stress disorder (PTSD). While the symptoms can be similar, the PTSD label reflects the cause of the behavioral problems (Perry, 2000).

Dissociation

Dissociation is a state of mind many of us have experienced. When we day dream, meditate, or use Lamaze childbirth exercises we are using dissociative techniques. Only when dissociation becomes pervasive is it a problem. Repeated and severe exposure to threat can lead to ongoing use of dissociation as a coping strategy (Perry, 2000).

If an infant’s cries do not provoke a helpful, comforting response from an adult, then over a period of time, the baby abandons crying and moves towards dissociation. He or she begins to disengage from stimuli. Children who cope this way often show behaviors related to oppositional-defiant disorder (Perry et al., 1995).

Disengagement is also linked to childhood depression and attachment problems. Foster parents may notice dissociation when a child emotionally detaches or “freezes” either physically or emotionally. Children who use this technique may act as if they have not heard if an adult asks them to comply with a directive. The adult’s response may then be to give another directive, perhaps with a threat or consequence. The tone and the words heighten the child’s anxiety further and he or she becomes more out-of-control, causing further dissociation (Perry et al., 1995).

The neurobiology of dissociation includes several chemical changes including increased circulation of epinephrine and stress steroids. There is also a decrease in blood pressure and heart rate (Perry et al., 1995). Perry et al. believe that the younger the child is when maltreatment occurs, and the more helpless, immobile and powerless the child is, the greater the likelihood of triggering a dissociative reaction. Females appear more likely than males to use dissociative processes and the presence of physical injury, pain or torture also increases the likelihood of dissociation.

Young children commonly use a combination of adaptive responses. An initial hyper-arousal response is designed to bring the caretaker to defend the child. If no help is forthcoming, the child is likely to become immobile (to “freeze”) and compliant (a continued from page 5
Early maltreatment can have profound and lasting effects on the developing child. One consequence is the development of Post-Traumatic Stress Disorder (PTSD). Between one-third and one-half of all abused children meet criteria for PTSD (Ackerman et al., 1998; McLeer et al., 1992; Widom, 1999 all cited in Hagle, 2005). PTSD is a set of symptoms that can develop following a person’s exposure to stress or trauma. The person must have witnessed or experienced an event or events that involved death or serious injury or threat to the physical integrity of self or others. The person’s response to the event(s) involved intense fear, helplessness, or horror. For children, the response might be expressed as disorganized or agitated behavior. 

The symptoms of PTSD fall in three broad clusters. First is recurring and intrusive memories of the traumatic event. In young children, this might be demonstrated by repetitive play where the child reenacts the themes or aspects of the trauma. The memories may be experienced in dreams. Children may have frightening dreams and be unable to verbalize the content. Some persons have “flashbacks” or time periods when they feel that the trauma is recurring. In young children this can sometimes be identified if the child reenacts the traumatic material. There can be intense psychological distress and physiological reactivity with exposure to either external or internal cues that symbolize or resemble the actual traumatic event(s). 

The second cluster is persistent avoidance of stimuli associated with the trauma and “numbing” of general responsiveness. Persons might avoid thoughts, feelings and conversations associated with the trauma as well as activities, places, or people associated with the trauma. There may be inability to recall aspects of the traumatic event(s). The person may show detachment and estrangement from others and a diminished interest in activities. Affect may be blunted or restricted or some emotions may be unable to be expressed. The person may have a sense of doom or a foreshortened future and not expect to have a normal life or career. 

The third cluster is characterized by symptoms of increased arousal such as hypervigilance, increased startle response, sleep difficulties, irritability, anxiety and hyper-reactivity. 

For children, the symptoms of PTSD present a more confusing diagnostic picture, although symptoms roughly fit into the three main clusters. Many children with PTSD have been diagnosed with co-morbid disorders such as Attention-Deficit Hyperactivity Disorder, Conduct Disorder, anxiety disorders, affective disorders, or even psychotic disorders. According to a study at the Center for Study of Childhood Trauma in Chicago, the only features clearly distinguishing the PTSD from other psychiatric problems for many children were: 1) a documented history of a severe traumatic event(s); 2) exacerbation of symptoms with re-exposure to trauma-specific stimuli; and 3) autonomic nervous system hyper-arousal (Perry, 1994).

Some children or youth may not meet full criteria for PTSD but still be chronically disturbed by specific trauma stress-related symptoms (Benoit, 2006). According to research by Perry, children traumatized within the first three years of life experience an apparent post-traumatic pervasive developmental delay while children with a stable first three years of life but traumatized later in childhood tend to show affective and anxiety symptoms similar to PTSD in adults. Severe trauma before age 4 also appears to result in a higher probability of pre-psychotic and psychotic symptoms. 

It is hypothesized that abnormal patterns of catecholamine activity associated with prolonged “alarm reactions” induced by traumatic events in infancy and early childhood result in altered development of the central nervous system (CSN). It is hypothesized that this altered development includes a ‘dysregulated’ (or poorly regulated) brainstem. Signs and symptoms of dysregulation including altered heart rate and cardiovascular regulation, affective labiality, impulsivity, high anxiety, increased startle response, and sleep abnormalities. A very consistent finding, according to Perry (1994), is hyper-arousal of the autonomic nervous system (ANS). 

Our bodies are programmed for “fight or flight” when confronted with dangerous or stressful conditions. A series of complex neurophysiological reactions occur in the brain, in the autonomic nervous system, in the hypothalamic-pituitary adrenocortical (HPA) axis, and in the immune system. These responses provide mobilization so the body can survive a life-threatening danger. The portions of the brain involved in arousal, attention, and concentration become activated, resulting in hypervigilance to the danger and a decrease in attention to other environmental stimuli. 

The neurophysiological activation during acute stress is usually rapid and reversible. However, if the stressful event is prolonged or repeated frequently, ‘sensitization’ occurs where the neurochemical systems change and become more sensitive to future stressful events. The major increase in catecholamine activity triggers changes that alter responsivity of the nervous system, resulting in the symptoms of PTSD discussed above. 

The Virginia Early Learning Council was formed in late spring, 2005 to initiate practical steps to a commitment to having all children have a chance to succeed. In October, 2005, the Virginia Early Learning Council released recommendations to ensure optimal development for Virginia’s youngest citizens. The recommendations were a result of a task force of public and private leaders who reviewed the current status of early childhood education in Virginia. Virginia has approximately 500,000 children younger than age 5, constituting approximately seven percent of the total population.

For more information about the Virginia Early Learning Council, contact Kathy Glazer, Early Childhood Initiatives Director, Virginia Department of Social Services, 7 North 8th Street, 6th Floor, Richmond, VA 23219 (804) 726-7120, E-mail: kathy.glazer@dss.virginia.gov

Brain Wonders

Brain Wonders: Helping Babies and Toddlers Grow and Develop is a special website about how the brain develops within the context of relationships from conception through three years of age. It is a collaborative project of Boston University School of Medicine, the Erikson Institute and Zero to Three and funded with support of the Maternal and Child Health Bureau, U. S. Department of Health and Human Services.

Visit the site and learn about early literacy. Take the “Brain Quiz.” Read information specific to parents, to health professionals, and to child care providers. Explore questions such as “Does hearing music affect an infant’s brain development?” “Is the constant playing of music harmful to an infant’s brain?” A section that corresponds to a baby or toddler’s age will offer the latest information about brain development and strategies to support a baby’s growth.

Visit the site at: http://www.zerotothree.org/brainwonders/

Spotlight: SMART BEGINNINGS

Ready for School - Ready for Life

Smart Beginnings is an initiative that belongs to every family, organization, business, agency and community interested in making the most of the years from birth to five for Virginia’s children. Smart Beginnings is a forum for dialogue, a convening of minds, a raising of awareness, a community embrace of finding ways to join hands to give every Virginia child the best start in life.

This statewide collaboration to share information and efforts is a remarkable opportunity to bring early child development to the forefront. It is a smart investment with gains for families, communities, the workforce and the economy. Some examples of why early investment in child care and education is a “win-win” situation:

- Children who enter school ready to learn:
  - are less likely to engage in criminal activity;
  - are more likely to buy a home and pay taxes;
  - are less likely to become pregnant as a teen;
  - have fewer special education years;
  - are more likely to graduate from high school;
  - are a better prepared and more skilled workforce;
  - need less help from income assistance programs.

Parents, families, early childhood professionals, community coalitions and business leaders are invited to join Governor Tim M. Kaine, the Virginia Early Childhood Foundation and its state and community partners in making Smart Beginnings for Virginia’s children a top priority.

More information is available from the Virginia Early Childhood Foundation (see separate article, this issue) or from the website at: www.smartbeginnings.org

SQUARE ONE offers 3-hour customized trainings throughout the Commonwealth to early care providers, caregivers, teachers and others. New course updates are available on the website.

Contact SQUARE ONE at 287 Independence Blvd., Virginia Beach, VA 23462, (757) 552-0293, E-mail: info@squareone.org or on line at www.sqone.org for additional information on customized trainings.

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During the past 25 years, a dramatic change has occurred in the U.S. in the way young children are cared for. The percentage of young children who experience regular child care has changed from 25% to over 80% with large numbers of children beginning care in their first two years of life.

There is a great need for public information about child care. Parents want to know if child care is safe, at what age they can leave their children, and how many hours of day care a child can manage. Parents wonder what type of day care (home or family, group, or academically-oriented) might be most beneficial. To answer such questions, NICHD designed a large-scale, comprehensive, in-depth longitudinal study to find the answers.

This volume summarizes data from the first 4.5 years of following 1364 children born in 1991 and brings together learnings from over 100 publications that have resulted from the study. Charlottesville, Virginia was one of the 10 data collection sites.

Readers will find this volume fascinating, exciting, and informative. Parenting emerged as a consistent and strong predictor of all child outcomes. Child-care quality was a consistent and modest predictor of most child outcomes and child-care quantity was a consistent and modest predictor of child social behavior. The type of child care was an inconsistent and modest predictor of cognitive and social outcomes.

The findings reveal that family matters and that quality of child care, both inside and outside the family is crucial. High quality, responsive care produces capable, cooperative, caring young children.
Spotlight: VECCS
Early Childhood
State Plan 2006

The federal Maternal and Child Health Bureau launched the State Early Childhood Comprehensive Systems Initiative in 2002. Its purpose is to enable state Maternal and Child Health directors to collaborate with partner agencies and stakeholders in developing comprehensive early childhood systems. The Virginia Department of Health initiated a state strategic planning process in 2003 to develop a plan of action. Throughout 2004-05, over 100 public and private partners met to create a vision for an early childhood integrated system for Virginia, and to identify system-building efforts to promote healthy families and children ready to enter school.

Nationally, it has been estimated that 25 to 40% of children are not ready to be successful in school. In Virginia, 31% of births are to single mothers and 13% of children are living in poverty. Assuring that children experience an environment which fosters their early development requires strong family involvement.

As part of the Virginia Early Childhood Comprehensive Systems grant, an environmental scan was conducted in order to identify the most pressing gaps and strengths in Virginia’s early childhood system. A planning meeting was held in October 2005 with key public and private partners. The outcome was a series of recommendations for improving Virginia’s service delivery to families with young children.

VECCS Early Childhood State Plan summarizes the findings and recommendations of the Virginia Early Childhood Comprehensive Systems Project. Interested readers can obtain a copy from the Virginia Department of Health, 109 Governor Street, 8 East, Richmond, VA 23219. (804) 864-7685, FAX: (804) 864-7722.

EARLY CHILDHOOD INTERVENTION

Empirical knowledge about the efficacy of early childhood intervention is hampered by a diversity of target populations and service models. There are also studies with inappropriate research designs and/or inadequate analysis (Shonkoff & Phillips, 2000). Even with limitations in studies, some principles that are effective have been identified.

Shonkoff & Phillips (2000) and the National Research Council, after an extensive review of existing literature, outline principles of effective interventions during the early years. Also, Knitzer & Lefkowitz (2006) of the National Center for Children in Poverty offer principles to guide policy, practice and advocacy. Some of the ideas are:

- Interventions that are tailored to specific needs have been shown to be more effective than services providing generic support.
- Use multiple entry points for family-focused screening, assessment, intervention and prevention (such as community health clinics, family court, juvenile justice system, substance abuse programs, and shelters).
- Programs that directly target everyday experiences of children appear more effective than those that use indirect methods to enhance the general quality of the caregiving environment.
- Services focused explicitly on parenting behaviors have greater impact on parent-child interactions than do general parent education efforts. Start with parents but do not neglect other family members, especially fathers who may live outside the home.
- Target important transitions in families’ lives (pregnancy, birth, entrance into early childhood programs, incarceration or probation).
- Enhance parental competency by creating greater understanding of the child’s special needs.
- The intensity of the service is important. Connect with families across as many settings as possible (such as churches, child care providers, resource agencies).
- The ultimate impact can depend on the degree to which families are able to incorporate specific intervention techniques into their everyday interactions with the child.
- For some but not all problems, earlier intervention is superior. Connect with families as early as possible (starting with prenatal care).
- There is no basis for concluding that individualized interventions provided after certain ages can have no positive effects.
- Use of well-trained and qualified staff results in better outcomes. Nurture the staff and make certain there are supports and consultation available.

According to Lynch (2005) there is a strong consensus among experts who have studied high quality early childhood development programs that these efforts have substantial benefits. Programs vary in their services but many offer both educational and health services (such as immunizations and health screenings), nutrition services, and some provide adult education and parenting classes.

Investments in high-quality early childhood development programs consistently generate benefit-cost ratios exceeding 3-to-1 or more than a $3 return for every $1 invested which is well above the 1-to-1 ratio needed to justify such investments (Lynch, 2005). According to the analysis of the Economic Policy Institute, a publicly-financed, comprehensive early childhood development program for all low-income families would cost billions of dollars annually, but would create a budget savings over time. By about the 17-year mark, the net effect on budgets for all levels of government would turn positive. The investment would improve the quality of life for millions of children, reduce crime, result in a more productive workforce and strengthen the overall economy.

The Rand Corporation also performed a cost-benefit analysis of early childhood programs (reported in the APA Division 37 Newsletter, July, 2000). They found that savings to the government were much greater than the costs. They note that it is important to target early interventions to those who will show the most benefit, since not all children and families responded equally well. The report says it was not known which eligibility criteria would generate the most positive cost/benefit ratio. There is also a question about whether the model programs studies to date can be accurately replicated and whether offering larger-scale programs will result in the same benefits.

Efforts to document the program effectiveness and to identify the factors that result in the greatest gains for children can assist educators and policy makers in making decisions about funding programs and program design.

Sources: The Advocate, July 2000; Exceptional Returns, (Lynch, 2005); Pathways to Early School Success (Knitzer & Lefkowitz, 2006); and Neurons to Neighborhoods: The Science of Early Childhood Development, 2000, edited by Jack P. Shonkoff and Deborah A. Phillips, National Research Council and Institute of Medicine, National Academy Press.
Early Brain Development

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Dissociative response) which in the extreme could include engaging in fantasy.

Differential reactivity is necessary for successful adaptation to the environment. The ability to respond according to the need seems to be lost in traumatized people who instead experience hyperarousal in response to stimuli suggesting the prior trauma and/or a dissociative reaction to the potential threat. Thus, traumatized children may be either overcompensated or blunted. The child continues to use the maladaptive emotional, behavioral and cognitive strategies which are rooted in the original response to the maltreatment—a response that was adaptive at the time of the trauma but maladaptive for long-term use (Perry et al., 1995).

How Maltreatment Affects Attachment

Traumatic events happen in the context of relationships (Pawl, 1987). When adults respond predictably and provide for an infant’s needs, the baby’s brain develops properly and the resulting attachment is secure. The infant whose physical needs are met and who receives proper stimulation from sensitive, responsive parents and caretakers can focus on exploring, learning, and experiencing all of the wonders of the world.

If the attachment system fails due to separation, loss, or through maternal deprivation, then the result is acute stress in the infant. Long-term consequences can occur such as chronic anxiety states, misdirected and inappropriate aggression, pathological mourning, acute distress, conduct disorders, intellectual impairments, and inability to form empathetic bonds with others (Kraemer, 1992). Some hypothesize these symptoms and response patterns are due to a rise in cortisol. For example, children with disorganized attachments exhibit a greater rise in cortisol and prolonged cortisol elevations (cited in Lott, 1998).

Neurological and Endocrine Changes After Maltreatment

Maltreatment causes broad changes in the endocrine system, including disruption of arousal and immune functioning. The brain responds to the stress of chronic, low-grade maltreatment in the same way that it does to an acute trauma. Both disrupt the neurological circuitry involved in learning as well as heightening the overall level of arousal.

Prolonged elevated concentrations of specific stress hormones are fatal to the cells in specific areas of the brain involved in inhibiting fear and anxiety (the amygdala). The amygdala serves two functions: it forms indelible memories of fear distinct from the factual memory of the maltreatment and it attaches the emotion of fear to memories—in essence, adding emotional color. It is hypothesized to contribute to heightened vigilance, enhancement of the startle response, and increased risk for anxiety disorders and depression (Charney et al., 1989).

Chronic stress increases adrenal responsiveness and elevated cortisol. While brief elevations following an acute stressor may enhance the child’s ability to respond to stress, prolonged hyperactivity of the hypothalamic-pituitary-adrenocortical (HPA) axis is associated with adverse physiological and behavioral effects. Consequences include cell death, cognitive impairments, inferior emotional regulation, and increased likelihood of passive avoidance-like behaviors. The effects are especially potent when the stress of maltreatment is experienced early in life (Hart, Gunnar & Cicchetti, 1996). Similar to what has been found in animal research, early-life traumatic experiences can permanently increase reactivity of the child’s HPA axis to subsequent stressors (Putman, 2005).

Another of the vulnerable areas of the brain is the hippocampus, a structure that is responsible for creating and retrieving factual memories (Bremner, 1999; Sapolsky, 2000). Damage to parts of the hippocampus and the medial prefrontal cortex results in an imbalance in memory processes augmenting the amygdalar fear system and disrupting declarative memory (or recall of factual information). Bremner (1999) hypothesizes that hippocampal dysfunction is connected to alterations in memory, such as the fragmented or delayed recall of traumatic memories of childhood abuse.

The damage occurs through two processes: (a) maltreatment directly enhances the performance of (or potentiates) the amygdala, and (b) the associated damage to the hippocampus and prefrontal cortex releases the “brakes” that inhibit the amygdala, thus indirectly potentiating the acquisition and expression of learned fear. Thus, the amygdalar memory system becomes more responsive. Fear reactions and impulsivity are heightened. This process can impact school performance as well as the incidental learning of facts and information from daily life conversations and experiences.

In 1997, Stein (cited in Teicher, 2002) found left hippocampal abnormalities in 21 adult women who had experienced sexual abuse as children and who either had PTSD or a dissociative disorder. The volume of the left hippocampus was significantly reduced but the right hippocampus was unaffected. The degree of the reduction correlated with the severity of the symptoms. In contrast to the women who had early life trauma, patients with PTSD from later life experiences (such as Vietnam veterans) had bilateral or right hippocampal atrophy (cited in Bremner, 1999). In 2001, Driessen (cited in Teicher, 2002) reported a 16 percent reduction in hippocampus size and an 8 percent reduction in amygdala size in adult women with a history of childhood maltreatment.

Bremner et al. (1997) found a 12% atrophy of the left hippocampus in adults with Post-Traumatic Stress Disorder associated with childhood abuse. There was nearly significant atrophy in the right hippocampus as well. The study controlled for age, gender, handedness, body size, education, alcohol abuse and ruled out depression as a confounding variable (cited by Sapolsky, 1996).

However, De Bellis (1999) did not find the predicted decrease in hippocampal volume in a study of 44 maltreated children, nor did Teicher in an analysis of 18 young adults with a history of repeated forced sexual abuse. Teicher’s group did find a 9.8 percent reduction in the size of the left amygdala. Teicher (2000) believes that the most likely explanation for the discrepancy in findings is that stress may exert a very gradual influence on the hippocampus, so adverse effects are not discernible until people are older.

Depression

Depression is one outcome of chronic stress. Altered activity of the HPA axis is associated with depression in maltreated children (Hart et al., 1995). While the neurobiological relationship is not fully understood, it is thought that the adaptive responses to maltreatment cause disregulation in the HPA axis (discussed above) which then results in chemical depression (Hart et al., 1995).

Social Impairments

The ability to feel remorse and empathy are built on experience. Children who lack emotional attachments to others or who fear others or who expect others to be hurtful will have many social deficits.
Altered cortisol reactivity in maltreated children may also relate to impairments in social competence. As noted before, the ability to respond proportionate to the danger is a necessary survival skill (Hart et al., 1995). Children who are hyperalert will show intense reactions to adults and peers that others are likely to experience as aversive or at least puzzling. Peers and others then initiate interactions less frequently, further isolating the maltreated child. Children who respond by dissociation will likely be experienced as frustrating or unpredictable and be avoided as well (Thompson & Calkins, 1999). Research in this area is very limited and few conclusions can be drawn.

**Cognitive Changes**

Carrey et al. (1995), similar to other researchers, found that abused children in their sample of 7- to 13-year-olds had reliably lower Verbal IQ scores than non-maltreated children. They note that, for maltreated children with chronically high anxiety, language skills in general are thought to be very susceptible to disruption. The chronic anxiety disrupts attention, short-term memory, and language-mediated concept formation such as abstract reasoning skills. Learning requires a state of attentive calmness. This is a state that traumatized children rarely achieve (Perry, 2001b).

**The Impact of Deprivation**

Deprivation during brain development may be the most destructive yet least understood area of child maltreatment. While rarely studied in humans, the impact of extreme sensory deprivation is the focus of hundreds of animal studies (Perry & Pollard, 1997). Animal studies suggest that a narrow window or critical period exists during which specific sensory experience is required for optimal brain development and organization. According to Perry et al. (1995) some of the most powerful clinical examples of this phenomenon relate to lack of attachment experiences early in life. The child who has been emotionally neglected early in life will exhibit profound attachment problems which are resistant to therapy, intervention, or replacement experiences later in life.

Perry and Pollard (1997) used neuroimagining to examine brain growth in a large group of neglected children. Dramatic differences from the norm suggesting decreased brain growth were observed in globally neglected children who had minimal exposure to language, touch, and social interaction. Children who experienced lesser deprivation, chaotic neglect or prenatal drug exposure did not show the extreme abnormalities (Perry & Pollard, 1997).

Shonkoff & Phillips (2000) summarize research on children reared in orphanages. Some of these children show remarkable recovery when placed in a better environment, while others have long-term impairments. Factors of importance include the length of time the child was deprived, the child’s degree of impairment at birth, and the stability and resources of the adoptive family. Children who experienced the most depriving circumstances (which included illness, malnutrition, frequent relocations and disruptions in care) were at increased risk of enduring behavioral problems and difficulties in peer relationships. Shonkoff & Phillips note that children seem capable of forming their first attachments to parents even when adopted or fostered later in the early childhood years, but it is unknown how long this adaptive capability endures.

**Long Term Neurobiological Consequences of Maltreatment**

Because activating the stress system puts growth-oriented processes “on hold,” frequent or prolonged periods of stress can negatively affect development throughout the growing years (Shonkoff & Phillips, 2000). Children with maltreatment-related damage to brain structures have enhanced sensations of fear in conjunction with poor learning and memory. They might accumulate vague dreads (such as body memories, omens, or a sense of a foreshortened future) throughout their lives without being able to articulate the reasons or origins of these fears. They struggle to create plausible explanations for experiences of intense and unexpected fright, associating their heightened arousal, as fear, to benign people and places. Fear becomes “free-floating” and easily associated with subsequent unrelated situations (Webb, 1998). A foster child who has difficulty trusting anyone and resists developing a relationship with foster parents and others, might exemplify this process.

**Implications for Adolescence and Adulthood**

The effects of maltreatment on the brain are cumulative. At a certain point enough brain damage is sustained from repeated exposure to stress hormones that symptoms appear. A distinct threshold exists for a range of neurological conditions, and it is a reasonable hypothesis to suggest a similar mechanism for stress-induced damage.

For example, the amygdala is a brain area that has close back-and-forth communication with areas of the brain involved in attention, memory, planning, and behavioral control. In animals, experimentally causing a hyper-stimulation of the amygdala (a process called “kindling”) seems to create a hyperstimulation of the fear-stress circuits of the brain and creates changes in behavior that resemble post-traumatic stress in humans. It is as if the fear circuits get locked on the “on” position and have trouble shutting off (Shonkoff & Phillips, 2000).

In kindling and in behavioral sensitization the child becomes more responsive to the same stimulus after repeated exposure, or after a single extreme exposure (Post, Weiss, & Pert, 1988; Van der Kolk, 1988). Kindling is a form of plasticity, meaning a process whereby neural circuits are changed by experience. If the child also experiences other forms of brain injury, such as blows to the head, shaking, seizures, or malnutrition the neurological vulnerability is compounded.

Children may be more or less resilient to stress based partly on genetic factors and based partly on the severity of stress experienced during childhood. As discussed before, predictable and controllable acute stress (such as an infant exploring but having a secure base with a nearby caretaker) builds resiliency while chronic, high levels of stress or unpredictable stress (such as in maltreatment) lead to disruptions in the neuroendocrine system and also heighten the risk for depression, gastrointestinal problems and premenstrual difficulties in later years (Charmandari, Souvatsgolu, & Chrousos, 2003).

**Bullying**

Any factors which increase the activity or reactivity of the brainstem (such as abuse) or decreases the moderating capability of the limbic or cortical areas (such as neglect) will increase the child’s potential for aggression and impulsive behaviors (Perry, 1997). In addition, hyperarousal can contribute to children presuming hostility in others even when it is undeserved. This attribution style continued on page 12
Increased Vulnerability to Subsequent Trauma

A disorder frequently associated with child maltreatment is Post-Traumatic Stress Disorder (PTSD) (see page 7 for particulars). Individuals with PTSD experience heightened, intrusive recall of the traumatic event, including dreams or flashbacks; have episodes of emotional numbing and disconnection from those around them; and actively avoid settings or cues that remind them of their maltreatment. For example, a child who was molested in a bathroom may have “accidents” to avoid going into the bathroom. The child who was beaten by an alcoholic parent may be overly upset if the foster parents use alcohol, even at a special event.

Although PTSD is often associated with exposure to events such as combat or natural disasters, most PTSD is the result of assault or abuse. Children are more vulnerable to developing PTSD after maltreatment or trauma than adults (North, Smith & Spitznagel, 1994; Pynoos et al., 1987). Girls seem to be at particular risk for developing PTSD in adolescence and adulthood (Resnick et al., 1993).

De Bellis et al. (1999) studied 44 children and adolescents who had all been sexually abused between the ages of 2 and 6 with some who had experienced physical abuse between ages 1 and 3 and who had witnessed domestic violence. The children were school-aged and had been in stable living arrangements for several years. All met criteria for PTSD and many were also depressed. The imaging data showed that, compared with a matched group of physically and mentally healthy children, the maltreated children had smaller brain volumes, fluid-filled cavities in the brain and smaller areas of connection between the left and right sides of the brain. The findings were correlated with the duration of trauma with children who had been abused longer showing the greatest differences from the controls.

Implications for Child Protective Services

Child protective services caseworkers serve some of the most severely traumatized children. It is therefore crucial that CPS workers be trained to recognize traumatic stress in maltreated children and that CPS workers understand the implications of maltreatment in early years on brain development. Children who are seriously maltreated in the early years are at extremely high risk for persistent mental health problems, for cognitive impairments, for problem-solving deficits, for social maladjustment and for poorly regulated emotions.

Several recent reports have focused on the need for collaboration between mental health and child welfare. They include the report from the Committee on Integrating the Science of Early Childhood Development (Shonkoff & Phillips, 2000) and the Pew Commission on Children in Foster Care (2004). CPS and foster care workers need to be aware of effective interventions and be able to connect traumatized children with professionals who are experienced in helping children develop skills and attachments to others.

Interventions to Promote Resiliency

Some children recover, at least partially, from maltreatment when they are removed from the deleterious conditions. Still, many children, even with the best of care, struggle with serious difficulties. While we do not know if damage or dysregulation is reversible, some scientists believe it is possible (Bremmer, 1999). Why one child improves while another does not can sometimes be explained by the extent and duration of the abuse or neglect. Other times, it can be difficult to predict who will have a positive response to intervention.

Timing

Those who feel that early intervention can be crucial cite a number of findings. For example, Craig Ramey of the University of Alabama at Birmingham reported that children who received services from ages 4 months to 5 years old showed better cognitive development than children who did not receive services until between ages 5 to 8 years (Shore, 1997, cited in National Clearinghouse, 2001).

Another example is a study by Rutter et al. (2000) of children reared in Romanian orphanages. When each child was 6 years old, researchers assessed what proportion of the adopted children were functioning in the normal range. They found that 69 percent of those adopted before age 6 months were functioning normally. That percentage dropped to 43 percent for children adopted between age 7 months and 2 years, and then to 22 percent for children adopted between the ages of 2 and 3.5 years (cited in National Clearinghouse, 2001).

It is important to note that while early intervention is preferred, later interventions can be helpful as well. Research suggests that there is continuing opportunity for people to change into adulthood and provides no evidence that there is some particular age beyond which intervention will fail to make a difference (Hawley, 1998).

Family and Community-Oriented Approach

Because children are dependent on others for their well being, many of the interventions for children treat the immediate family. Much
research suggests that the small community in which a child lives can be powerful in helping a child recover from the effects of maltreatment. For example, the effects of bonding failure can sometimes be mitigated by the early introduction of a caring adult. “Researchers who examined the life histories of children who succeeded despite many challenges in their lives have consistently found that these children have had at least one stable, supportive relationship with an adult (usually a parent, other relative or teacher) beginning early in life” (Hawley, 1998, p. 3).

It is important for caretakers to have realistic expectations. Love and a positive environment alone are unlikely to be sufficient for brain change. The caretaker must also be willing to be very persistent as often the infant or child will not reciprocate or appreciate the caretakers’ efforts. Five key needs have been identified: nurturance; stability; predictability; understanding; and support. The positive experiences need to be frequent and repeated to begin to show effectiveness (National Clearinghouse, 2001).

While there are limits to what can be changed, the good news is that a child’s brain is remarkably plastic (Stein & Kendall, 2004). An interactive treatment model is based on the principle that the environment can change brain circuitry. Interpersonal experiences do have the power to change the brain. Teachers, friends, coaches, extended family, and neighbors can assist in cushioning a child from the impact of the maltreatment by fostering a child’s strengths.

**Traditional Therapies**

“Talk” therapies can be ineffective if a child is in a persistent hyperarousal state. Children with this reaction will be centered on nonverbal cues and their responses to the verbal interaction will be impaired (National Clearinghouse, 2001). The child will have difficulty reflecting thoughtfully on causes and prevention of inappropriate responses. They may employ distraction to divert the adult who wants to talk or they may become overly argumentative. They may need to control the session and those around them due to fear. Novelty and challenge (within the therapy session or elsewhere) may be met with withdrawal. The clinician and others will first need to help the child regulate emotions before relying upon traditional verbal approaches (Thompson & Calkins, 1996).

**Importance of Understanding the Child’s History**

An understanding of how the abuse or neglect can affect brain development and the child’s behavior can assist both professionals and caregivers in responding effectively to maltreated children (Perry, 2006). To provide the most helpful therapeutic assistance, clinicians must have a thoughtful appreciation of how and why the maladaptive strategies of emotional regulation were forged in the circumstances of risk and maltreatment (Thompson & Calkins, 1996).

The importance of a comprehensive evaluation cannot be over-stressed. The development of the therapeutic relationship begins with evaluation and the assessment is critical to further progress (Greenwald, 2006). Knowing a child’s history and his or her unique response patterns can allow foster parents and teachers to be aware of events that will be triggers to problem behaviors. Those in the child’s immediate environment can reduce or limit his or her exposure to aversive events. Clinicians, foster parents and others can teach the child to prepare him or herself and can find ways to gradually build the child’s skill level in coping with stimuli (Sandler et al., 1997; Thompson & Calkins, 1996).

**Approaches to Intervention**

Rather than a medical model, Perry (2006) and the ChildTrauma Academy advocate what they term as NMT or Neurosequential Model of Therapeutics. The model relies on matching therapeutic activities to the child’s specific developmental stage and physiological needs. The interventions seek to change the brain, so they must activate those portions of the brain that have been adversely affected by the maltreatment. Perry and Marcellus (2004) delineate 5 key concepts that must apply to all interventions. They must be consistent, repeated so they become familiar, provide nurturance, be predictable and facilitate control being returned to the child.

For example, a young child growing up in a home with pervasive threat will create a set of associations between a host of neutral cues and threat. These associations become automatic and there is very little reasoning involved. For the rest of the child’s life, these cues will have the capacity to elicit a fear response and therefore alter the child’s behavior. The fear-inducing cues can be scents, facial expressions, music, or even interpersonal styles of interaction. In order to change these inaccurate and false associations, the child must have opportunities for new experiences that will allow the brain to decrease the overgeneralization of these trauma-related associations.

**CHILDTRAUMA ACADEMY**

In 1990, Bruce Perry, MD, founded the Center for the Study of Childhood Trauma at St. Joseph Carondelet Children’s Center, a nonprofit agency in Chicago. In 1992, the Center became Child Trauma Programs and moved to Houston when Dr. Perry became the Chief of Psychiatry at Texas Children’s Hospital, an affiliate of Baylor College of Medicine. In 1994, CIVITAS Initiative, Chicago-based communications foundation became a major funding partner and from 1995 to 1998 the name became the CIVITAS ChildTrauma Programs.

During this time, the Programs’ focus shifted to interdisciplinary educational activities, non-medical models of care and cross-agency collaboration. Therefore, in 1998, the name changed to The ChildTrauma Academy in recognition of the shift.

The mission of the ChildTrauma Academy is to help improve the lives of traumatized and maltreated children and their families by improvising the systems that educate, nurture, protect and enrich these children. The work of the Academy is built on the belief that the most effective approach to systems change involves defining specific problems and developing innovative, measurable, and replicable solutions within clinical practice, program development, and public policy.

The ChildTrauma Academy conducts its work within a sphere of collaboration with individuals and organizations that share its vision. Over the years, the organization has built effective partnerships with corporate, public, and private organizations to help sustain multiple projects. Two primary activities of the organization are 1: program consultation and development and 2) education and training. The scope of the Academy’s work includes clinical practice, education, research, public, policy, and public awareness. Visit its website and experience the wealth of information available to professionals and the public alike. For reviews of two selected resources (“Bonding and Attachment in the Maltreated Child” and “The Vortex of Violence”) see VCPN volume 73.


Available from: The Haworth Maltreatment and Trauma Press, 10 Alice Street, Binghamton, New York, 13904-1580 (800) 429-6784, FAX: (800) 895-0582 E-mail: orders@HaworthPress.com Web site: www.haworthpressinc.com

This book is a remarkable tool for clinicians and therapists who work with children who are maltreated or who experience other types of trauma. Along with its companion volume (Real Life Heroes: A Life Storybook for Children, $12.95) the book is filled with practical, step-by-step methods that offer hope and relief to children and their caretakers. The author begins by explaining how trauma causes damage to neurodevelopment and how trauma affects attachment. The remainder of the book is devoted to methods for rebuilding attachments and re-parenting the hurt child.

Kagan aims to change the child’s future, moving from shame to strength. In the process, the child rebuilds a story of people who care and who can be the child’s real life heroes. “By connecting with these real people, traumatized children can belong to a family and a community and can embrace positive futures.
Animal-Assisted Therapy

Animals provide avenues for building empathy, rapport, feelings of acceptance, and nurturing abilities. Animals can help children reduce stress and can enhance socialization. For youth who have issues with touch, animals can provide a way to learn to reach out physically to others and to reconnect with tactile sensations (Brooks, 2005).

The Delta Society (see block, below) differentiates two types of animal-assisted interventions. “Animal-assisted activities” (AAA) are more casual “meet and greet” activities that can be repeated with many people. These activities provide opportunity for motivational, educational, recreational and/or therapeutic benefits that enhance the quality of life. They can be delivered in a variety of environments by specially-trained professionals, paraprofessionals, or volunteers. An example is taking dogs to nursing homes or to a children’s treatment center to allow the residents to interact with and visit with the dogs. There are no goals specific to each resident, there is no requirement for taking notes, and the visits can be long or short.

“Animal-assisted therapy” (AAT) differs from animal-assisted activities. AAT is a specific, goal-directed intervention that is documented and the individual’s progress is measured. The intervention is designed within a professional’s specialty area to improve the child’s physical, emotional, social and/or cognitive functioning. For example, an occupational therapist might use a cat to assist in developing a child’s fine motor skills. The child learns to negotiate the clasps on collars, the latches on the animal carrier, opens containers of treats for the cat and feeds the cat. An educator who is working on improving a child’s ability to sequence events may use a dog to help. The child learns to sequence grooming (secure the dog; get the grooming tools; untangle knots in the fur; brush the dog; and so on). A psychotherapist who is working with a child who is anxious and fearful can use learning to ride a horse as part of the therapy to increase self-confidence.

Assessment

As with any intervention, assessment is a prerequisite. In the case of AAT, the clinician must assess both the child client and the animal. The animal must enjoy being part of the treatment team and want to interact with child clients. Even an experienced animal should be assessed on a daily basis for willingness and temperament. The animal’s safety must be assured. The therapist must know that the animal is well-cared for with appropriate veterinary care, food, shelter, rest, exercise, and play.

The child’s general mental status should be assessed, along with any disabilities that might interact with the animal (such as allergies; motor limitations; impulse-control problems; acting-out behaviors). Observing the death of a pet or animal may make it difficult for a child to attach to an animal and may trigger painful memories. Sometimes abusive parents hurt pets or threaten to hurt or kill pets as a means of control of the child. Children should be asked directly if they have ever seen a pet be hurt or die and whether he or she has ever hurt or killed a pet (Brooks, 2005).

Clinicians should note the developmental level of the child and how that may differ from the child’s functional level. Moral development should also be assessed, especially the child’s understanding of “right” and “wrong” behavior towards living creatures. Knowing the child’s level of functioning, developmentally and morally, helps the clinician structure the intervention (Brooks, 2005).

Interventions

The animal assisting in the psychotherapy session is considered a partner and is respected and chosen for its temperament and characteristics. The animal is specially trained for its role in the intervention. The clinician appreciates the animal’s unique strengths, limitations, and fears. Not all animals are effective therapy animals.

Adding an animal to therapy should be thoroughly discussed beforehand. It should not be a surprise. Including an animal in the therapy relationship has the potential for benefit but also can detract from the therapy. The timing can be important.

Two models exist and each is useful. The “triangle model” is when a therapist and the animal work with the child. The “diamond model” includes a therapist, the child, the animal, and a handler for the animal. In the latter model, the therapist and the handler must have a good pre-established relationship.

The therapist must be knowledgeable about animal behavior and must be able to help the child interpret the animal’s responses. The nuances of the interactions between the child and the animal create the milieu where the child’s growth can proceed (Brooks, 2005). The child must become engaged and be interested in the animal. The interaction needs to help the child discover something about him or herself.

References Available Upon Request
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Parts of the brain can not be changed unless they are activated. Thus repetition, repetition, and more repetition is a fundamental principle. The number of times the intervention must be repeated can be “frustratingly high” (Perry, 2006, p. 37) and thus a roadblock for foster parents and others. “It is not that a child won’t change; it is just that change will not occur unless sufficient repetitions are provided” (Perry, 2006, p. 43). Traumatized children can change but the process is long and requires patience and understanding.

Trauma-related symptoms originate in the lower parts of the brain. Therefore, interventions that seek to change these symptoms must influence the brainstem. According to Perry (2006), efforts to treat symptoms related to higher parts of the brain without first regulating the brainstem will be inefficient or unsuccessful. Traumatized children age but do not develop. Therefore, therapeutic (replacement) experiences must be developmentally appropriate, but not completely age-inappropriate. This is a major challenge as children become older.

In some cases, Perry (2006) recommends the process begins with animals. Dogs, for instance, have the capacity to provide unconditional acceptance and repetitive nurturing experiences. Dance, music, drumming and massage are other avenues. The patterned, repetitive sensory input may help the brain reorganize.

It is important to foster a sense of control in children who have been maltreated. When the child is learning new responses, the adult should illustrate ways the new methods will increase the child’s control and mastery (Sandler et al., 1997). Modeling of techniques is important as well. Adults should narrate as they demonstrate so the child hears the thinking and rationale behind the technique (Sandler et al., 1997). It is beneficial to have the maltreated child associate with same-aged children who function well and can act as peer models and be friends. Caretakers should search for supportive and appropriate peer models to enhance their own modeling effects (Eisenberg, Fabes & Guthrie, 1997).

Providers and adults relating to the children should avoid anger (which will likely trigger the child’s anxiety) and concentrate upon solving the problem. Caretakers should gently correct negative thinking and offer alternative formulations (Eisenberg, Fabes & Guthrie, 1997).

Medications can be helpful, but medication won’t create new, healthy neural pathways and networks (Perry, 2006). Others (Webb, 2006) have noted that some parents are reluctant to medicate young children. Providers should recognize that use of medication is a controversial issue.

As mentioned above, therapeutic or enrichment services must be consistent, predictable, patterned and frequent. Weekly therapy is too meager, therefore the therapist must recruit caregivers, teachers and parents to assist. The need is for 1:1 interaction. Perry (2006) notes that many children fail to improve for lack of sufficient resources. He states, “Our systems are rarely capable of providing this level of relational attention” (p. 46).

Stages of Therapy

Stein and Kendall (2004) suggest that treatment falls into three stages: safety and stabilization; symptom reduction and memory work; and developmental skills.

Stage I: Safety and Stabilization

The child must feel safe in order to start to heal. The child must be protected from maltreating adults. Caretakers must establish limits and boundaries. A predictable daily structure can reinforce the child’s sense of control and counteracts a tendency to regress (Stein & Kendall, 2004).

Self-destructive and violent behaviors need to cease. Time-outs, relaxation techniques, and practicing safe alternatives all can assist the child in learning to self-sooth. Parents and teachers can reinforce the child’s efforts and can offer incentives for the child’s efforts.

Stage II: Symptom Reduction and Memory Work

In this stage, the clinician helps the child learn how to become calm without the use of dissociation. Progressive relaxation training, dance, singing, water and sand play can all decrease arousal and start to restore the natural rhythms of the body. Exercise and skill-building activities (sports; animal-assisted therapy) can be useful. Active techniques such as relaxation therapy can be combined with aspects of cognitive therapy (Carrey et al., 1995).

In this stage of therapy, children need to learn how to seek comfort from others. Abuse teaches that dependency is dangerous. Children may act as if they have no need of others and may fight to be in control. Consistent empathy and acts of kindness are small bridges to the child.

One goal is learning to feel feelings and tolerate affect. Gradual exposure that allows the child to stay in control is critical. Desensitization techniques can be useful. Well-lit spaces and eye contact can counteract the child’s tendencies to disconnect from reality.

A bedtime routine that is comforting, yet empowering can counteract nightmares. The parent can help the child recall the successes of the day and read together with the child books that send a message of empowerment and success (Stein & Kendall, 2004).

Techniques to help the child tell the story of the trauma include play techniques, joint story-telling, and drawings. The story comes in bits and pieces and the therapist helps to structure and arrange it. Cognitive restructuring of false or inaccurate beliefs, healing imagery (guided imagery) and other techniques described above are helpful (Stein & Kendall, 2004; Webb, 2006).

Group therapy, when available, may be helpful, especially for sexually-abused girls. Readers who are interested in a review of treatments that are clinically proven for sexually-abused children can request VCPN, Volume 63.

Stage III: Developmental Skills

Once emotional regulation has improved, the child may benefit from more traditional “talk” and cognitive therapies. As mentioned before, traumatized children have siphoned energy into hyperalertness and have failed to develop critical skills in language, problem-solving, social skills and self-awareness. Building cognitive capacities enhances the development of the cortex, especially the prefrontal area and makes it more likely that children can thoughtfully evaluate their behaviors. There are many ways to teach problem-solving. Stein & Kendall (2004) advocate teaching a 5-step approach: 1) Define the problem; 2) Think about feelings; 3) Consider alternative solutions; 4) Anticipate consequences; 5) Take action. Eisenberg, Fabes & Guthrie (1997) suggest direct instruction on how to appraise stressful events, identifying courses of action, and reinforcing coping behaviors.

Activities to enhance self-awareness and self-knowledge are vital. Maltreated children need to try many different activities in order to discover where their talents lie. They need feedback and encouragement as they have likely missed developing basic skills and may be delayed compared to their peers. As Perry notes, activities must be “relevant, relational, repetitive, and rewarding” (2006, p. 49).

Social skills training is especially valuable for children who are very inhibited and those who are very aggressive. Finally, therapists and foster parents need to help the child develop a value system.

Prevention

Direct efforts to protect and enhance brain

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development during pregnancy and early years is essential. Prevention efforts include prenatal and postnatal care, improved nutrition, early detection of infant impairments, and parent-education programs.

The key concept is to ensure that parents provide enriching cognitive, emotional, social and physical experiences for the child (Perry, 2001b). This starts with education efforts about basics such as nutrition, preventative health care, and how to find quality child care (Hawley, 1998).

Summary

The past 20 years have seen unprecedented progress in understanding how the brain develops, particularly during prenatal and postnatal periods. Much of the fundamental knowledge about brain development is still based on studies with animals as subjects. Sometimes translating information from animals to humans is straightforward but at other times it is not. Thus, excitement about new learning must be balanced with cautions about the limitations of current knowledge.

Brain development begins well before birth, extends into adult years, and is interactive with the environment. While some compensation can occur in later development, what happens early in a child’s life matters. Abusive or neglectful care or exposure to dangerous or toxic environments (such as domestic violence; war) are manifest risks for healthy brain development (Shonkoff & Phillips, 2000).

Teicher (2000) hypothesizes that exposure to extreme stress produces adaptive responses that may help the child reach reproductive years and thus help the survival of the human species. The heightened arousal responses, increased aggression and wariness may insure survival but the cost is large- a host of psychiatric problems and acceleration of aging and brain deterioration. Whether it is war, famine, or maltreatment, stress can permanently change the child’s brain in an attempt to cope with a malevolent world.

Brain research has implications for the entire network of persons who seek to help maltreated children. The research underscores the importance of prevention and early intervention, as brain change can be difficult to accomplish. Brain research offers some guidance to CPS workers, especially in regard to the importance of comprehensive evaluation for children entering foster care. Brain research can allow the professionals and foster parents to understand the importance of creating systems that provide consistency and predictability while giving the child some control.

One lesson of brain research is that the environment has a powerful effect on the brain. Stable, nurturing caregivers and knowledgeable professionals can have significant impact on children’s development. While we continue to study the brain and its growth, we can begin to use the insights that are already available to optimize intervention and prevention efforts.

References Available Upon Request

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