Mindful
Continuing Education

The Effects of Child Maltreatment on Brain Development

This issue brief provides basic information on typical brain development and the potential effects of abuse and neglect on that development. The information is designed to help professionals understand the emotional, mental, and behavioral impact of early abuse and neglect in children who come to the attention of the child welfare system.

How the Brain Develops

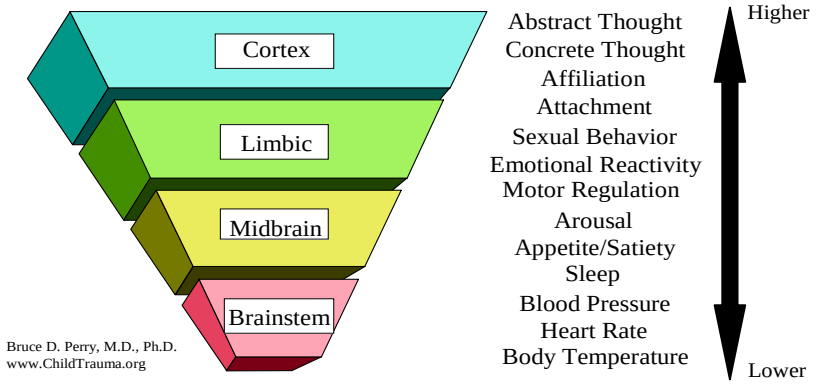
What we have learned about the process of brain development helps us understand more about the roles both genetics and the environment play in our development. It appears that genetics predispose us to develop in certain ways, but our experiences, including our interactions with other people, have a significant impact on how our predispositions are expressed. In fact, research now shows that many capacities thought to be fixed at birth are actually dependent on a sequence of experiences combined with heredity. Both factors are essential for optimum development of the human brain (Shonkoff & Phillips, 2000).

Early Brain Development

The raw material of the brain is the nerve cell, called the *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) (Perry, 2000a).

The first areas of the brain to fully develop are the brainstem and midbrain; they govern the bodily functions necessary for life, called the autonomic functions. 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 (ZERO TO THREE, 2012). (See Exhibit 1 for more information.)

Exhibit 1 – Functions of Brain Regions



The Growing Child's Brain

Brain development, or learning, 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. This is the essence of postnatal brain development, because 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.

The development of synapses occurs at an astounding rate during a child's early years in response to that child's experiences. At its peak, the cerebral cortex of a healthy toddler may create 2 million synapses per second (ZERO TO THREE, 2012). By the time children are 2 years old, their brains have approximately 100 trillion synapses, many more than they will ever need. Based on the child's experiences, some synapses are strengthened and remain intact, but many are gradually discarded. This process of synapse elimination—or pruning—is a normal part of development (Shonkoff & Phillips, 2000). By the time children reach adolescence, about half of their synapses have been discarded, leaving the number they will have for most of the rest of their lives.

Another important process that takes place in the developing brain is *myelination*. Myelin is the white fatty tissue that forms a sheath to insulate mature brain cells, thus ensuring clear transmission of neurotransmitters across synapses. Young children process information slowly because their brain cells lack the myelin necessary for fast, clear nerve impulse transmission (ZERO TO THREE, 2012). Like other neuronal growth processes, 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. Also, like other neuronal growth processes, a child's experiences affect the rate and growth of myelination, which continues into young adulthood (Shonkoff & Phillips, 2000).

By 3 years of age, a baby's brain has reached almost 90 percent of its adult size. The growth in each region of the brain largely depends on receiving stimulation, which spurs activity in that region. This stimulation provides the foundation for learning.

Adolescent Brain Development

Studies using MRI techniques show that the brain continues to grow and develop into young adulthood (at least to the midtwenties). White matter, or brain tissue, volume has been shown to increase in adults as old as 32 (Lebel & Beaulieu, 2011). 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. MRI comparisons between the brains of teenagers and the brains of young adults have shown that most of the brain areas were the same—that is, the teenage brain had reached maturity in the areas that govern such abilities as speech and sensory capabilities. The major difference was the immaturity of the teenage brain in the frontal lobe and in the myelination of that area (National Institute of Mental Health, 2001).

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).

Plasticity—The Influence of Environment

Researchers use the term *plasticity* to describe the brain's ability to change in response to repeated stimulation. The extent of a brain's plasticity is dependent on the stage of development and the particular brain system or region affected (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, this brain plasticity is what allows us to keep learning into adulthood and throughout our lives.

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. For example, our brains are "wired" to respond to the sound of speech; when babies hear people speaking, the neural systems in their brains responsible for speech and language receive the necessary stimulation to organize and function (Perry, 2006). The more babies are

exposed to people speaking, the stronger their related synapses become. If the appropriate exposure does not happen, the pathways developed in anticipation may be discarded. This is sometimes referred to as the concept of "use it or lose it." It is through these processes of creating, strengthening, and discarding synapses that our brains adapt to our unique environment.

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

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. Animal studies have shed light on sensitive periods, showing, for example, that animals that are artificially blinded during the sensitive period for developing vision may never develop the capability to see, even if the blinding mechanism is later removed.

It is more difficult to study human sensitive periods, but we know 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 trusting, durable bonds if they are in a severely neglectful situation with little one-on-one caregiver contact. Children from Romanian institutions who had been severely neglected had a much better attachment response if they were placed in foster care—and thus received more stable parenting—before they were 24 months old (Smyke, Zeanah, Fox, Nelson, & Guthrie, 2010). 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.

Memories

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 to put one foot in front of the other to walk. They 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, refers to conscious memories and is tied to language development. Explicit memory 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). This may be the case with very young children or infants who suffer abuse or neglect.

Responding to Stress

We all experience different types of stress throughout our lives. The type of stress 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** is moderate, brief, and generally a normal part of life (e.g., entering a new child care setting). Learning to adjust to this type of stress is an essential component of healthy development.
- **Tolerable stress** 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** includes strong, frequent, and prolonged activation of the body's stress response system (e.g., chronic neglect).

Healthy responses to typical life stressors (i.e., positive and tolerable stress events) are very complex and may change depending on individual and environmental characteristics, such as genetics, the presence of a sensitive and responsive caregiver, and past experiences. A healthy stress response involves a variety of hormone and neurochemical systems throughout the body, including the sympathetic-adrenomedullary (SAM) system, which produces adrenaline, and the hypothalamic-pituitary-adrenocortical (HPA) system, which produces cortisol (National Council on the Developing Child, 2014). Increases in adrenaline help the body engage energy stores and alter blood flow. Increases in cortisol also help the body engage energy stores and also can enhance certain types of memory and activate immune responses. In a healthy stress response, the hormonal levels will return to normal after the stressful experience has passed.

Effects of Maltreatment on Brain Development

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, 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). For example, healthy brain development includes situations in which babies' babbles, gestures, or cries bring reliable, appropriate reactions from their caregivers. These caregiver-child interactions—sometimes referred to as "serve and return"—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 hyperalert 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.

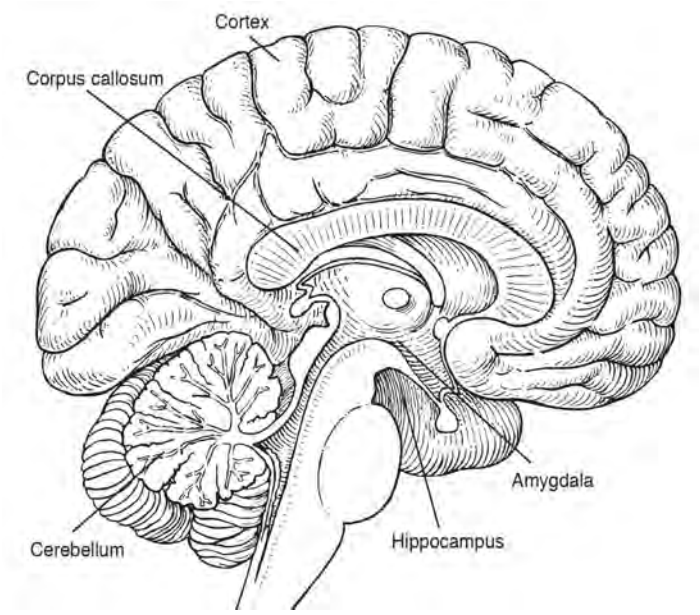
Effects of Maltreatment on Brain Structure and Activity

Toxic stress, including child maltreatment, can have a variety of negative effects on children's brains:

- **Hippocampus:** Adults who were maltreated may have reduced volume in the hippocampus, which is central to learning and memory (McCrory, De Brito, & Viding, 2010; Wilson, Hansen, & Li, 2011). Toxic stress also can reduce the hippocampus's capacity to bring cortisol levels back to normal after a stressful event has occurred (Shonkoff, 2012).
- **Corpus callosum:** 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 inter-hemispheric communication and other processes (e.g., arousal, emotion, higher cognitive abilities) (McCrory, De Brito, & Viding, 2010; Wilson, Hansen, & Li, 2011).
- **Cerebellum:** Maltreated children and adolescents tend to have decreased volume in the cerebellum, which helps coordinate motor behavior and executive functioning (McCrory, De Brito, & Viding, 2010).
- **Prefrontal cortex:** Some studies on adolescents and adults who were severely neglected as children indicate they have a smaller prefrontal cortex, which is critical to behavior, cognition, and emotion regulation (National Scientific Council on the Developing Child, 2012), but other studies show no differences (McCrory, De Brito, & Viding, 2010). Physically abused children also may 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).
- **Amygdala:** Although most studies have found that amygdala volume is not affected by maltreatment, abuse and neglect can cause overactivity 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).
- **Cortisol levels:** 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.
- **Other:** 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).

Exhibit 2 provides an illustration of these brain areas.

Exhibit 2—Brain Diagram



Credit: Tapert, S. F., Caldwell, L., & Burke, C. (2004/2005). Alcohol and the adolescent brain: Human studies. *Alcohol Research & Health, 28*(4), 205–212.

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 (n.d.), 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.

Epigenetics

A burgeoning field of research related to brain development is epigenetics. Epigenetics refers to alterations to the genes that do not include structural changes to the DNA nucleotide sequence (Orr & Kaufman, 2014). An epigenetic modification occurs when chemical "signatures" attach themselves to genes, which, in turn, helps determine how the genes are expressed (i.e., whether they are turned on or off). These changes can affect the expression of genes in brain cells, may be permanent or temporary, and can be inherited by the person's offspring (National Scientific Council on the Developing Child, 2010a). The chemical experiences are initiated by life experiences, both positive and negative, as well as nutrition and exposure to toxins or drugs (National Scientific Council on the Developing Child, 2010a).

Although the field of epigenetics is still in its infancy, studies have indicated that child maltreatment can cause epigenetic modifications in victims. In one study of individuals with posttraumatic stress disorder (PTSD), those who had been maltreated as children exhibited more epigenetic changes in genes associated with central nervous system development and immune system regulation than nonmaltreated individuals with PTSD (Mehta et al., 2013). Furthermore, the findings indicated that the maltreated individuals had up to 12 times more epigenetic changes than nonmaltreated individuals, which may mean that maltreated individuals may experience PTSD uniquely and may require different types of treatment than other groups with PTSD. Another study found decreased hippocampal glucocorticoid receptor expression, which affects HPA activity, in suicide victims with histories of child abuse compared to nonabused suicide victims (McGowan et al., 2009).

Effects of Maltreatment on Behavioral, Social, and Emotional Functioning

The 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 hild'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, such as PTSD (National Scientific Council on the Developing Child, 2010b).

Hyperarousal. 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 *hyperarousal*. 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, like a classroom. 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.).

Increased Internalizing Symptoms. 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 (Herringa 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).

Diminished Executive Functioning. 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) (National Scientific Council on the Developing Child, 2011). 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).

Delayed Developmental Milestones. 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. For example, babies need to experience face-to-face baby talk and hear countless repetitions of sounds in order to build the brain circuitry that will enable them to start making sounds and eventually say words. If babies' sounds are ignored repeatedly when they begin to babble at around 6 months, their language may be delayed. In fact, neglected children often do not show the rapid growth that normally occurs in language development at 18–24 months (Scannapieco, 2008). 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).

Weakened Response to Positive Feedback. Children who have been maltreated may be less responsive to positive stimuli than nonmaltreated children. A study of young adults who had been maltreated found that they rated monetary rewards less positively than their peers and demonstrated a weaker response to reward cues in the basal ganglia areas of the brain responsible for reward processing (Dillon et al., 2009).

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.

Impact of Maltreatment on Adolescents

The effects of maltreatment can continue to influence brain development and activity into adolescence and adulthood. These effects may be caused by the cumulative effects of abuse or neglect throughout their lives or by maltreatment newly experienced as an adolescent.

Most teens act impulsively at times, but for teens who have been maltreated, this impulsive behavior may be even more apparent. Often, these youth have developed brains that focus on survival, at the expense of the more advanced thinking that happens in the brain's cortex (Chamberlain, 2009). An underdeveloped cortex can lead to increased impulsive behavior, as well as difficulties with tasks that require higher-level thinking and feeling. These teens may show delays in school and in social skills as well (Chamberlain, 2009). They may be more drawn to taking risks, and they may have more opportunities to experiment with drugs and crime if they live in environments that put them at increased risk for these behaviors. Maltreatment as a younger child can have longitudinal negative effects on brain development during adolescence. Adolescents with a history of childhood maltreatment can have decreased levels of growth in the hippocampus and amygdala compared to nonmaltreated adolescents (Whittle et al., 2013). Adolescents also may experience the effects highlighted in the previous section.

Implications for Practice and Policy

The knowledge we gained from research examining the effects of maltreatment on brain development can be helpful in many ways. With this information we are better able to understand what is happening within the brains of children who have been abused and neglected. In fact, much of this research is providing concrete/scientific evidence for what professionals and caregivers have long described in behavioral, emotional, and psychological terms. 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. For example, children who lived in Romanian institutions and then moved into foster care settings had larger total volumes in cortical white matter and the posterior corpus callosum than children who remained in institutional care (though these volumes were smaller than never-institutionalized children) (Sheridan, Fox, Zeanah, McLaughlin, & Nelson, 2012). We can use this information to improve our systems of care and to strengthen our prevention efforts.

The Role of the Child Welfare System

While the goal of the child welfare system is to protect children, many child welfare interventions—such as investigation, appearance in court, removal from home, placement in a foster home, etc.—may actually reinforce the child's view that the world is unknown, uncontrollable, and frightening. A number of trends in child welfare may help provide a more caring view of the world to an abused or neglected 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 use of differential response to ensure children's safety while providing nonadversarial support to families in low-risk cases
- The promotion of evidence-based practices

Federal Focus on Trauma-Informed Care

More child welfare agencies are using a trauma-informed approach to serve children and families. They are considering the impact of traumatic events, such as maltreatment, domestic violence, being separated from loved ones, and the effects of poverty, on children and families and incorporating practices that acknowledge the effects of current and intergenerational trauma. During the past decade, the U.S. Department of Health and Human Services (HHS) has emphasized the use of trauma-informed care by agencies and professionals. It funded grants focusing on this approach, such as the Promoting Well-Being and Adoption After Trauma cluster (2013) and the Integrating Trauma-Informed and Trauma-Focused Practice in Child Protective Service (CPS) Delivery cluster (2011). (For more information about the latter cluster, view the related Children's Bureau Express article at https://cbexpress.acf.hhs.gov/index.cfm?event=website.viewArticles&issueid=132&articleid=3392.) HHS also has incorporated trauma-informed care into its guidance to States, including a letter to all the directors of State and Tribal child welfare agencies (see http://www.hhs.gov/secretary/about/blogs/childhood-trauma-recover.html).

For more information about trauma-informed care, visit Child Welfare Information Gateway at https://www.childwelfare.gov/topics/responding/trauma.

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. By the time a child who has been abused or neglected comes to the attention of professionals, some negative effects are likely. Prevention efforts should focus on supporting and strengthening children's families 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 ("primary" or "universal" prevention) by educating the public and changing policies to promote healthy brain development. Prevention efforts also may target children and families considered to be at-risk of developing problems ("secondary" or "selected" prevention).

Prevention efforts for at-risk families should focus on strengthening the family and building on the family's positive attributes. Recent prevention resource guides from the HHS Children's Bureau (2015) encourage professionals to promote six "protective factors" that can strengthen families, help prevent abuse and neglect, and promote healthy brain development:

- Nurturing and attachment
- Knowledge of parenting and of child and youth development
- Parental resilience
- Social connections
- Concrete supports for parents
- Social and emotional competence for children

Brain research underscores the importance of prevention efforts that target the youngest children. For example, early childhood home visiting programs for expectant and new mothers, who might be at-risk because of their age, income, or other circumstances, show promise for mitigating maternal stress, thus keeping adversity from becoming toxic stress (Garner, 2013). Parent education programs also serve as a prevention method that can promote protective factors and lead to positive outcomes for both parents and children. The Centers for Disease Control and Prevention (CDC) developed the Essentials for Childhood Framework to help communities prevent child maltreatment. This framework is based on establishing safe, stable, and nurturing relationships between children and caregivers. (See http://www.cdc.gov/ViolencePrevention/childmaltreatment/essentials/index.html for more information.)

Early Intervention. Intensive, early interventions when the brain is most plastic are much more effective than reactive services as the child ages (Perry, 2009). In recognition of this fact, Federal legislation requires States to develop referral procedures for children ages 0–36 months who are involved in a substantiated case of child abuse or neglect. Once a child is identified, States must provide intervention services through Early Intervention Plans funded under Part C of the Individuals with Disabilities Education Improvement Act. A number of States developed innovative programs to meet these requirements and to identify and help the youngest victims of abuse and neglect (Child Welfare Information Gateway, 2013). (For more information about early intervention, refer to *Addressing the Needs of Young Children in Child Welfare: Part C—Early Intervention Services* at https://www.childwelfare.gov/pubs/partc/.)

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 not be limited to weekly therapy appointments. 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.

The following are examples of models and interventions available to child welfare and related professionals to assist children and youth who have been maltreated or otherwise exposed to toxic stress:

- **The neurosequential model of therapeutics (NMT)** is based on the fact that the higher brain functions

(e.g., speech, relational interactions) depend on input from lower brain functions (e.g., stress responses) (Perry, 2009). Many clinical interventions, however, focus on the higher brain functions rather than the lower brain functions, which may be the source of the child's issues. NMT has three central elements: (1) a developmental history that helps delineate the timing, nature, and severity of developmental challenges; (2) a current assessment of functioning to help determine which neural systems and brain areas are affected and what the developmental level of the child is in various areas (e.g., speech, social skills); and (3) specific recommendations for the interventions to be used, with a focus on the sequence of the interventions (i.e., focusing on deficits in the lower brain first and progressing to the higher brain functions).

- **The Attachment and Biobehavioral Catch-up (ABC) for Infants and Young Children** intervention is designed for the parents of young children who have experienced early adversity (Dozier & Fisher, 2014). ABC is implemented during 10 sessions in the parents' homes and includes both the parents and children. The sessions focus on providing clear feedback to parents about nurturance and following their child's lead, and include the review of video clips of interactions between the parents and child. A study of ABC found that children who received the intervention showed a steeper slope of cortisol production and higher wake-up cortisol values (i.e., healthier cortisol levels) than nonintervention children (Dozier & Fisher, 2014). These effects were still seen even at 3 years after the intervention.
- **Multidimensional Treatment Foster Care for Preschoolers (MTFC-P),** which typically lasts 9 to 12 months, helps parents learn and practice behavior management techniques (Dozier & Fisher, 2014). This helps children experience a more controlled and stable environment, which, in turn, helps enhance their regulatory capabilities. Foster parents are trained prior to placement, and program staff are available 24 hours a day to provide support. A support group is available, too. Children also participate in a weekly therapeutic playgroup to practice self-regulatory skills. If children will be returning to their birth families, MTFC-P staff provide training to the birth parents as well. Similar to the ABC intervention, children receiving MTFC-P had more stable cortisol levels than those who did not receive MTFC-P (Dozier & Fisher, 2014).

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. The Children's Bureau developed a guide, *Making Healthy Choices: A Guide on Psychotropic Medications for Youth in Foster Care*, to help adolescents better understand their options. The guide is available at https://www.childwelfare.gov/pubs/makinghealthychoices. For more information about psychotropic medications, visit Child Welfare Information Gateway at https://www.childwelfare.gov/topics/systemwide/mentalhealth/effectiveness/psychotropic.

The Role of Caregivers

Many children who suffered abuse and neglect are removed from their homes (for their safety) by the child welfare system. Extended family, foster parents, or group home staff may temporarily care for these children, and some will be adopted. In these cases, educating caregivers about the possible effects of maltreatment on brain development, and the resulting symptoms, may help them to better understand and support the children in their care. Child welfare workers may also want to explore any past abuse or trauma experienced by parents that may influence their parenting skills and behaviors.

It is important for caregivers to have realistic expectations for their children. Children who havebeen abused or neglected 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:

- Be unable to control their emotions and have frequent outbursts
- Be quiet and submissive
- Have difficulties learning in school
- Have difficulties getting along with siblings or classmates
- Have unusual eating or sleeping behaviors
- Attempt to provoke fights or solicit sexual experiences
- Be socially or emotionally inappropriate for their age
- Be unresponsive to affection

Understanding some basic information about the neurobiology underlying many challenging behaviors may help caregivers shape their responses more effectively. They also need to know as much as possible about the particular circumstances and background of the individual children in their care.

In general, children who have been abused or neglected 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 lives in an abusive or neglectful environment, the harder it will be to convince the child's brain that the world can change. Consistent nurturing from caregivers who receive training and support may offer the best hope for the children who need it most.

Summary

In 2012, approximately 686,000 children were determined to be victims of abuse and/or neglect (U.S. Department of Health and Human Services, 2013), but it is likely that many more children are actually suffering under adverse conditions. These children may have already suffered damage to their growing brains, and this damage may affect their ability to learn, form healthy relationships, and lead healthy, positive lives.

One lesson we have learned from the research on brain development is that environment has a powerful influence on development. Stable, nurturing caregivers and knowledgeable, supportive professionals can have a significant impact on these children's development. Focusing on preventing child abuse and neglect, helping to strengthen families through trauma-informed systems and practices, and ensuring that children receive needed services are some of the most important efforts we can undertake.

Glossary

- **Amygdala**: A component of the limbic system that is involved in the expression and perception of emotion[1]
- **Axon**: The fiber-like extension of a neuron through which the cell carries information to target cells[1]
- **Basal ganglia**: Deeply placed masses of gray matter within each cerebral hemisphere that assist in voluntary motor functioning[2]
- **Brainstem**: The structure at the base of the brain through which the forebrain sends information to, and receives information from, the spinal cord and peripheral nerves[1]
- **Cerebellum**: A portion of the brain that helps regulate posture, balance, and coordination[1]
- **Cerebral cortex**: The intricately folded surface layer of gray matter of the brain that functions chiefly in coordination of sensory and motor information. It is divided into four lobes: frontal, parietal, temporal, and occipital[2]
- **Corpus callosum**: The largest white matter structure in the brain. It connects the left and right cerebral hemispheres and facilitates communication for emotion and higher cognitive abilities[3]
- **Cortisol**: A glucocorticoid produced by the adrenal cortex that mediates various metabolic processes, has anti-inflammatory and immunosuppressive properties, and whose levels in the blood may become elevated in response to physical or psychological stress[2]
- **Epigenetics**: The study of how environmental factors like diet, stress, and post-natal care can change gene expression (when genes turn on or off) without altering DNA sequence[4]
- **Executive functioning**: A group of skills that help people focus on multiple streams of information at the same time and revise plans as necessary[5]
- **Frontal lobe**: One of the four divisions of each cerebral hemisphere. The frontal lobe is important for controlling movement, thinking, and judgment[1]
- **Gray matter**: Neural tissue, especially of the brain and spinal cord, that contains cell bodies as well as some nerve fibers, has a brownish gray color, and forms most of the cortex and nuclei of the brain, the columns of the spinal cord, and the bodies of ganglia[2]
- **Hippocampus**: A component of the limbic system that is involved in learning and memory[1]
- **Hypothalamic-pituitary-adrenocortical (HPA) system**: A hormonal system that produces cortisol in the outer shell of the adrenal gland to help regulate the body's stress response system[6]

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[1] National Institutes of Health, National Institute on Drug Abuse. (2010). *The brain: Understanding neurology*. Retrieved from http://science.education.nih.gov/supplements/nih2/addiction/other/glossary/glossary.html

[2] National Institutes of Health, National Library of Medicine, MedlinePlus (http://www.nlm.nih.gov/medlineplus/mplusdictionary.html)

[3] Hart, H., & Rubia, K. (2012). Neuroimaging of child abuse: A critical review. *Frontiers in Human Neuroscience, 6*. Retrieved from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3307045/

[4] National Institutes of Health, National Institute of Mental Health. (n.d.). *Brain basics.* Retrieved from http://www.nimh.nih.gov/health/educational-resources/brain-basics/brain-basics.shtml#Glossary

[5] National Scientific Council on the Developing Child. (2011). *Building the brain's "air traffic control" system: How early experiences shape the development of executive function* (Working Paper 11). Retrieved from http://developingchild.harvard.edu/index.php/resources/reports_and_working_papers/working_papers/wp11/

[6] National Scientific Council on the Developing Child. (2014). *Excessive stress disrupts the architecture of the developing brain* (Working Paper 3). Retrieved from http://developingchild.harvard.edu/resources/reports_and_working_papers/working_papers/wp3/

- **Limbic system**: A set of brain structures that regulates our feelings, emotions, and motivations and that is also important in learning and memory. Includes the thalamus, hypothalamus, amygdala, and hippocampus[1]
- **Midbrain**: The upper part of the brainstem, which controls some reflexes and eye movements[7]
- **Myelin**: Fatty material that surrounds and insulates axons of some neurons[1]
- **Neuron**: A unique type of cell found in the brain and body that is specialized to process and transmit information[1]
- **Neurotransmitter**: A chemical produced by neurons to carry messages to other neurons[1]
- **Plasticity**: The capacity of the brain to change its structure and function within certain limits. Plasticity underlies brain functions, such as learning, and allows the brain to generate normal, healthy responses to long-lasting environmental changes[1]
- **Prefrontal cortex**: A highly developed area at the front of the brain that plays a role in executive functions such as judgment, decision-making, and problem-solving, as well as emotional control and memory[4]
- **Receptor**: A protein that recognizes specific chemicals (e.g., neurotransmitters, hormones) and transmits the message carried by the chemical into the cell on which the receptor resides[1]
- **Sensitive period**: Windows of time in the developmental process when certain parts of the brain may be most susceptible to particular experiences
- **Sympathetic-adrenomedullary (SAM) system**: A hormonal system that produces adrenaline in the central part of the adrenal gland to help regulate the body's stress response system and triggers the "fight or flight" response[6]
- **Synapse**: The site where presynaptic and postsynaptic neurons communicate with each other[1]
- **Temporal lobe**: One of the four major subdivisions of each hemisphere of the cerebral cortex that assists in auditory perception, speech, and visual perceptions[1]
- **White matter**: Neural tissue, especially of the brain and spinal cord, that consists largely of myelinated nerve fibers bundled into tracts that help transmit signals between areas of the brain. It gets its name from the white color of the myelin[2]

Additional Resources

California Evidence-Based Clearinghouse for Child Welfare (CEBC)—The CEBC identifies and disseminates information about evidence-based practices in child welfare, including trauma treatment for children and youth. http://www.cebc4cw.org/topic/trauma-treatment-for-children/

Center on the Developing Child—Founded and directed by Jack Shonkoff, M.D., the Center publishes and links to research on early brain development, learning, and behavior and how to apply that knowledge to policies and practices. www.developingchild.harvard.edu

Centers for Disease Control and Prevention (CDC)—The CDC website offers several publications that promote safe, stable, and nurturing relationships to prevent child maltreatment. CDC also sponsors the Adverse Childhood Experiences study. http://www.cdc.gov/ViolencePrevention/childmaltreatment/essentials/index.html http://www.cdc.gov/violenceprevention/acestudy/

Child Trauma Academy—This website offers online courses, trainings, and other resources on early brain development and the impact of maltreatment. www.childtrauma.org/

From Neurons to Neighborhoods: The Science of Early Childhood Development—This book was written in 2000 by a committee of experts (Committee on Integrating the Science of Early Childhood Development, J. P. Shonkoff and D. A. Phillips, eds.). It highlights findings of neurobiology and explores how we can nurture and protect young children. http://www.nap.edu/catalog/9824/from-neurons-to-neighborhoods-the-science-of-early-childhood-development.

The National Child Traumatic Stress Network—This federally funded initiative is a collaboration of academic and community-based service centers with a mission to improve access to care, treatment, and services for traumatized children and adolescents. The website includes an assortment of publications, toolkits, and trainings. http://www.nctsn.org/

ZERO TO THREE—This national nonprofit organization offers resources, training, and support for professionals and parents of young children. The online Baby Brain Map is a useful tool for showing how brain development parallels very young children's behavior/ http://www.zerotothree.org/ www.zerotothree.org/site/PageServer?pagename=ter_util_babybrainflash

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