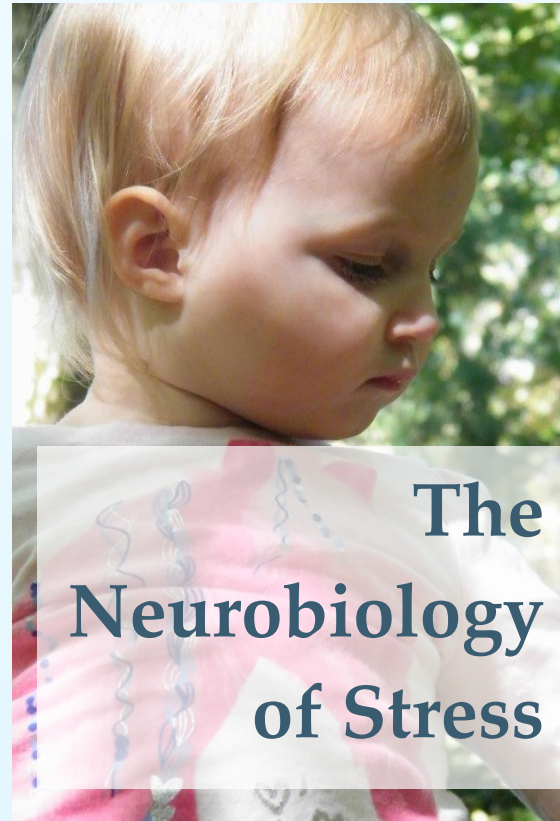


Early social and emotional experiences are important to the developing brain. Unlike other organs, the brain is undeveloped at birth, waiting for experiences to shape how it will develop (Perry, 2008). What happens to children in the first years of life has a direct impact on future actions and responses as each new experience is filtered through past experiences.

The human brain is extremely malleable and adaptable, particularly in early childhood. The combination of positive social and emotional experiences and the presence of healthy, nurturing relationships contribute to a child's optimal development, including the ability to cope with and benefit from various challenges. On the other hand, the absence of healthy experiences and influences, combined with prolonged or toxic stress, leads to disruptions in development, dysregulation in bodily function, and lifelong consequences in all developmental domains (National Scientific Council on the Developing Child, 2005).

Community service providers across many disciplines—including mental health, substance abuse services, child maltreatment prevention and early education—are paying close attention to the research in neurobiology related to trauma and stress. This information helps ensure that services and supports for families will be more effective. Providers who apply current research to their work with those who are most vulnerable (e.g., families at risk of abuse and neglect) or impressionable (e.g., women expecting a baby or caring for young infants) are better able to promote the factors that can buffer children from detrimental exposure to stress.

This research brief provides a summary of our current understanding of the connection between early experiences of stress and the potential impact of those experiences on the body and developing brain. Included here is an explanation of the types of stress people experience, the systems involved in reacting to stress, and the responses to traumatic stress. There are also brief descriptions of the major regions of the brain involved in receiving and interpreting input, whether the stimulus is negative or positive. This document is not intended to cover every aspect on the impact of stress and trauma on the developing brain, but rather provide an overview with a list of additional resources and select websites to guide further study.



Types of Stress

Stress can be generally defined as strain or pressure exerted on a person. It is always present in our lives and can be an effective teaching tool as one learns to manage and persevere through difficult experiences. Stress can be positive, tolerable, or toxic depending on how much the body and brain are taxed and how long the events or experiences last. The resulting impact also depends on whether the stressful experience is perceived as controllable, as well as how often and for how long the stress system has been activated in the past (National Scientific Council on the Developing Child, 2005).

Extensive research by neuroscientist Dr. Bruce McEwen, concerning the effects of stress on the body and brain has demonstrated the impairing effects of too much stress in terms of dysregulation and physical well-being. McEwen refers to this phenomenon as “chronic wear and tear” on the cardiovascular and other systems. According to research on excessive stress, severe stress or abuse can result in the development of a smaller brain. “Even less extreme exposure to toxic stress can change the stress system so that it responds at lower thresholds to events that might not be stressful to others, thereby increasing the risk of stress-related physical and mental illness.” (National Scientific Council on the Developing Child, 2005. See *Working Paper #3*, referenced later, for more details.)

The problem, according to McEwen, is not from predictable, day-to-day stress, which actually teaches us how to survive and persevere. Rather, prolonged exposure to physiological or psychological stress results in over-use or over-activation of the brain’s stress response and mediation systems (McEwen, 2008; Shonkoff & Garner, 2012). The extent to which stressful events have lasting adverse effects is determined by an individual’s past experiences, genetic traits, and his or her capacity to adapt to challenges.

Stress Response 101

The National Scientific Council on the Developing Child describes three types of stress responses that occur in a child’s body:

- *Positive:* This is moderate, short-lived and involves brief increases in heart rate and mild changes in hormone levels. This ideal type of stress allows the brain and body to work together to process the input.
- *Tolerable:* This activation of the stress response system lasts longer and requires time for the brain and body to recover. If there is not a supportive caregiver to serve as a “buffer” to the stress, more serious or potentially harmful effects can develop.
- *Toxic:* Stressful events that are unpredictable, chronic, or uncontrollable trigger the stress response system more frequently. Compounded when there is no support from caring adults, this prolonged activation can “disrupt the development of brain architecture and other organ systems, and increase the risk for stress-related disease and cognitive impairment.”

Stress and the Brain

The brain is made up of incredible and complex components that are connected through billions of neurons that are constantly working. Every brain is different, and each difference is related to an individual's personal experiences combined with genetics. The regions that play an important role in responding to stress are described below.

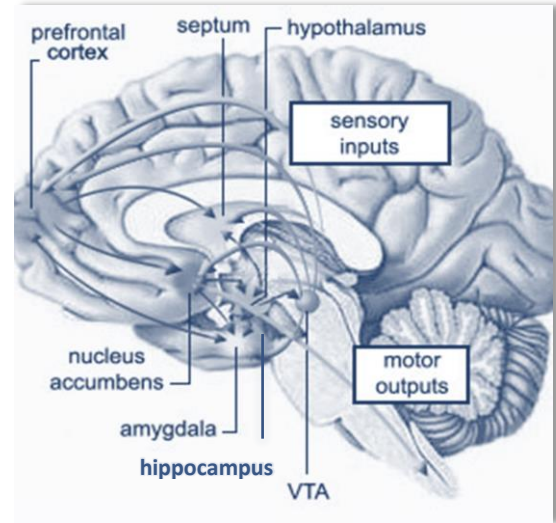
Amygdala: This area triggers the familiar "fight or flight" response. The amygdala is responsible for raw emotions and is associated with fear or alarm. When stimulated by cortisol and adrenaline, the amygdala shuts down the hippocampus, hindering the ability to take in information.

Anterior Cingulate Cortex: This area connects the amygdala with the prefrontal cortex; it helps monitor conflict and errors, and plays an important role in regulating emotion and focusing attention. This area connects emotions to cognition or turns feeling into action.

Hippocampus: This area is critical to forming new memories and learning new facts and information. Central to the stress response system, it is extremely vulnerable to chronic stress, because stress disrupts the healthy function of this area. Since all levels of understanding include the hippocampus, the brain is impaired when the neurons are not connecting properly.

Nucleus Accumbens: This area is referred to as the "pleasure center," playing a central role in controlling the brain's "reward circuit." In connection with the ventral tegmental area (VTA), it mediates reward, motivation and punishment. Toxic stress can lead to seeking unhealthy rewards through drug or alcohol use or relapse in those struggling with addiction.

Prefrontal Cortex: This section is referred to as the brain's "executive center." It facilitates rational thinking and decision-making, and helps keep the amygdala in check. The PFC is compromised and inactive under prolonged toxic stress, ultimately inhibiting rational decision-making (Southwick & Charney, 2012).



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The body's reaction to stress is mediated in large part by the limbic system, the emotional center that makes the complex connections between the sensory system, the nervous system, hormones and major organs (McEwen, 2006; Perry, 2005). With positive or even tolerable levels of stress, neurotransmitters work within all areas of the brain, sending the proper signals to allow us to think, act, feel and form new memories (Perry, 2013).

When a person is exposed to a threat or danger, even if it is just a perceived danger, the body naturally responds by releasing stress hormones such as cortisol, dopamine and norepinephrine (or adrenaline), which send signals throughout the entire system. These hormones, when not excessively activated, cue the body to respond appropriately and protectively, helping the individual survive challenging or traumatic situations.

However, chronically or permanently elevated adrenaline and cortisol levels are detrimental to an individual's well-being and healthy development. Too much cortisol has a negative impact on the proper functioning of the limbic system, the prefrontal cortex, and the body's immune system, which over the long term can lead to severe and sometimes lasting damage throughout all of these systems (AAP, 2012; Perry, 2013).

When faced with significant emotional stimulus, the body naturally releases adrenaline, which is imperative to preparing the body for action. When a child's adrenal system is activated repeatedly by negative stimulus, that experience becomes connected with particular emotions that are easily triggered later. Like cortisol, too much adrenaline impedes proper brain functioning and taxes other bodily systems. Every experience contributes to the formation of memory and ultimately behaviors and future actions. Since the brain develops after birth, and is extremely vulnerable to all input, the more certain pathways are activated early on, the greater the effect on the developing systems.

Stress Response in Children

Toxic stress inhibits the brain's ability to adjust to elevated cortisol levels. It also makes discriminating between safety and danger difficult. (AAP, 2012). The stress response is further complicated for young children who are still growing and developing, and who present different coping skills and perceptions of what is within their control compared to adults. Moreover, young children are not yet equipped to handle extreme stress, and their systems are much more vulnerable to chemical influences such as elevated cortisol, prolonged noradrenalin, dopamine and serotonin released by the sympathetic nervous system (AAP, 2012; Shonkoff & Garner, 2012). Simply put, children respond to stress differently than adults.

No matter how resilient or capable of handling stress a child may seem, when a child is faced with adversity, his or her brain is signaling to get out of the situation. A child's ability to persevere through difficult circumstances is also dependent upon the presence of a consistently available caregiver. For example, when young children encounter new situations that seem threatening, such as starting the first day of school or entering an unfamiliar doctor's office, their stress response system is activated: their hearts may beat faster, they may grasp tightly to their parents, and they may even try to run out or hide. An attentive and supportive caregiver can calm the child's fears and reduce anxious feelings through touching, talking through the new exposures, describing what can be expected next and providing reassurances that everyone is safe. The absence of this type of support leaves the child in a heightened state of arousal, reliant only on past experience and closed to absorbing information and opportunities to learn.

Responses to Traumatic Stress

When faced with a situation that is perceived as dangerous, the human response is typically manifested in one of two ways, otherwise known as the "fight or flight" response.

The "fight" response usually involves an activation of the nervous system (increasing heart rate, blood flow and muscle tone); general hyper-arousal, and over-activity in an attempt to "fix" or remedy the situation.

For example, older children may appear aggressive when attempting to protect younger siblings in what are perceived as dangerous situations.

The "flight" response can cause a child to attempt to physically escape (e.g., running away or hiding), to freeze, or to escape emotionally, which manifests as avoidant behaviors. In a state of fear, infants appear frozen since they don't have the physical ability to move away from danger. The flight response for children may include keeping feelings bottled-up, refusing to speak or make eye contact, or trying to escape reality through other means, which may look like fantasy play (in young children) and drug or alcohol use (in older youth).

Implications for Family Support

Dr. Bruce Perry, M.D., Ph.D. and Senior Fellow for the Child Trauma Academy, describes three common disruptions to development of which family support staff need to be aware. “These disruptions resulting in a cascade of problems for the entire system are:

- Prenatal exposure to drugs and alcohol
- Disruptions to the perinatal attachment
- Traumatic stress and/or chronic state of distress (e.g., neglect)” (Perry, 2013).

Drawing on this research, the Child Trauma Academy recognizes that trauma—though experienced differently by each individual—is rooted in neurobiology and therefore affects the whole body. Over time these emotional or physical challenges lead to behaviors and reactions that are often misdiagnosed or misinterpreted. The Child Trauma Academy has worked to integrate these concepts into clinical practice, which results in services that match the needs of the children being served.

Family support staff and others working with vulnerable populations should also consider the neurobiological connections between traumatic stress and child development. Understanding how chronic stress actually changes the brain architecture can help caregivers and family support workers better understand the entire family system, including the behaviors and reactions observed in children. To be effective in our work with families we must strive to learn more about how stress affects the brain and body and how exposure to trauma can manifest in a myriad of ways, complicated by genetics and family dynamics.

Did You Know...? Although we have no conscious memory of the earliest experiences in infancy, it is these first experiences that become the building blocks for life. (*First Impressions: Exposure to Violence and A Child’s Developing Brain*, 2008. www.ccfca.gov)



Summary

The way each person perceives and reacts to traumatic experiences and stress is very complex and dependent on a range of variables and an individual’s unique qualities. It is important for providers to recognize both what is occurring in the brain and body under duress and the efforts that can help counteract those impacts.

The younger a child is when they experience toxic stress, the more likely they are to have pervasive problems later.

Prolonged exposure to excessive stress in a child’s life makes them extremely vulnerable to future health problems. Having this information and sharing it with parents at the appropriate time and place can help them recognize how important their support is to their child.

Understanding the impact of trauma on the developing child can also help providers and caregivers interpret behaviors and respond accordingly, hopefully avoiding misinterpreting what are actually children’s reactions to traumatic stress.

learn more



For More Information

Listed below are a few additional resources on the topics discussed in this brief.

McEwen, B.S. (2008). Central effects of stress hormones in health and disease: Understanding the protective and damaging effects of stress and stress mediators. *European Journal of Pharmacology*. 583(2-3): 174-185.

McEwen, B.S. (2006). Protective and damaging effects of stress mediators: Central role of the brain. *Dialogues in Clinical Neuroscience*. 8(4).

National Scientific Council on the Developing Child (2005). *Excessive stress disrupts the architecture of the developing brain: Working Paper #3*. <http://www.developingchild.net>

Perry, B.D. (2002). *Understanding traumatized and maltreated children: The core concepts*. www.childtraumaacademy.org

Perry, B.D. (2004). *Maltreatment and the developing child: How early childhood experience shapes child and culture*. The Margaret McCain Lecture Series, an initiative of: The Centre for Children and Families in the Justice System.

Shonkoff, J.P. and Garner, A.S. (2012). *The lifelong effects of early childhood adversity and toxic stress*. American Academy of Pediatrics Technical Report.

For a complete list of references for this research brief, contact me@hornbyzeller.com.

Select Websites for More Information

The Center on the Developing Child at Harvard www.developingchild.harvard.edu

The Child Study Center www.aboutourkids.org

The Child Trauma Academy www.childtrauma.org

The Search Institute www.search-institute.org

Zero to Three www.zerotothree.org

Contact Prevent Child Abuse Iowa ▶▶▶

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See companion Research Brief: *Promoting Resilience* at www.pcaiowa.org



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