The brain grows and develops from the inside out or bottom up, from primitive, impulsive functioning to less reactive functioning. As the brain grows, more complex parts (neocortical) moderate, modulate, and control the lower parts (e.g., the brainstem).

- The brain grows through repetitive sensory experiences.
- It matures in its size depending on the way it learns to tolerate frustration, modulate emotion, and channel aggression.

Ideally, both hemispheres develop in a balanced way due to appropriate nurturing and stimulation. In this ideal world, the left brain and the sympathetic nervous system which deals with terror, rage, and excitement and the right brain with the parasympathetic nervous system (both together comprising the Autonomic Nervous System or ANS) which deals with shame, guilt, helplessness, and hopelessness, develop in a parallel fashion.

The mind-body connection produces a psychobiological response. It refers to the fact that children’s brains and bodies are integrally involved in the development and manifestation of emotions, cognitive processes, and behaviors.
The brain is programmed by genetics in a sequenced process.

There are specific windows and sensitive periods when certain brain regions are susceptible to formative experiences as well as critical periods that require appropriate stimulation.

Exposure to traumatic events during these windows of vulnerability have pronounced effects on brain development over time. For example, child sexual abuse impacts the hippocampus to the greatest degree when it occurs between ages of 3-5 or 11-13, and the corpus callosum is most impacted between the ages of 9 and 10.

Everything a child does, thinks, and feels is associated with the brain. As a result, traumatic events have the potential to alter brain functioning.

Chronic trauma may even lead to structural changes in the brain (Cohen, Mannarino, and Deblinger, 2006).

In one study, children who had a history of sexual abuse, physical abuse, or exposure to domestic violence were found to have smaller brain sizes, lower IQs, poorer grades, and higher disassociation scores than children without traumatic histories (DeBellis et al., 1999).

Some professionals believe that only certain types of therapeutic activities can access the affected brain pathways.

**The Effect of Trauma on the Brain**

The brain experiences a sequence of events when it experiences a traumatic event.

- Terror alters chemical functioning and molecular organization in the brain.
- Altered chemical functioning creates heightened sensitivity to stressors/triggers.
- Stressors/triggers create a noradrenaline surge(s) and impact the development of synapses and the myelin sheath.
- Noradrenaline surges create arousal/hyperreactive states across brain regions.
- Hyperreactive/arousal states stimulate survival responses and a persistent fear state ensues which can become systemic wide and, if severe enough, can impact behavioral, emotional, and cognitive development.

Trauma hyperactivates the sympathetic and parasympathetic systems making a child less able to regulate the intensity of emotions. This puts stress on the organs of the body and can lead to physical problems.
Factors Affecting Brain Dysfunction

The degree of brain dysfunction depends on numerous factors:

- **Timing**: what part of the brain is developing at the time of the traumatic event?
- **Nature (type) of the event**: e.g., does it lead to continued stress or does it encompass a lack of sensory stimulation?
- **Pattern**: one time (Type I) or repetitive and chronic (Type II) duration?
- **Agency**: who or what is responsible?

Four to 8 weeks of exposure to traumatic events can suppress dendritic growth in the hippocampal regions related to episodic semantic memory and can lead to cell loss; it also can lead to programmed alertness.

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The **Amygdala**

Trauma impacts the brain’s limbic system, which includes the amygdala.

The amygdala is a lower brain part and a complex brain structure located deep within the medial temporal lobe; its older part deals with olfactory stimuli. The amygdala:

- Alerts the body and brain to danger and threat.
- Contains the emotional memory system.
Is involved in fear conditioning.

Reacts to triggers of past trauma recovery education and counseling center and is the grand central station for sensory information.

Is altered by and stores information about emotional events in implicit memory.

Helps with regulation or modulation functions such as attention and perception.

Processes the emotional significance of external stimuli.

Leads the way for a release of hormones and neurotransmitters that can alter cognitive processing.

Hyper-responsiveness of the amygdala can lead to PTSD.

**The Hippocampus**

Traumatic events also impact the hippocampus, which is associated with declarative/explicit/verbal memory.

The hippocampus:

- Lies behind and interacts with the amygdala and is interconnected with other system structures.
- Helps individuals learn and remember (encode) new word-based memories.
- Encodes content during fear conditioning.
- Has a higher level of activity in general in those diagnosed with PTSD.
- Can change in size and volume, leading to extensive problems with memory and learning.

**Cortisol and Adrenalin**

When an individual encounters perceived threats, the hypothalamus – a tiny region at the base of the brain – sets off an alarm system in the body. Through a combination of nerve and hormonal signals, this system prompts the body’s adrenal glands, located atop the kidneys, to release a surge of hormones, including adrenaline and cortisol.

Adrenaline increases heart rate, elevates blood pressure and boosts energy supplies. Cortisol, the primary stress hormone, increases sugars (glucose) in the bloodstream, enhances the brain’s use of glucose and increases the availability of substances that repair tissues. Cortisol also curbs functions that would be nonessential or detrimental in a fight-or-flight situation. It alters immune system responses and suppresses the digestive system, the reproductive system and growth processes. This complex natural alarm system also communicates with regions of the brain that control mood, motivation and
fear. Initially, these hormones responsible for the physical “flight or fight” response have positive effects:

- A quick burst of energy for survival reasons
- Heightened memory functions
- A burst of increased immunity
- Lower sensitivity to pain
- Helps maintain homeostasis in the body

The body's stress-response system is usually self-regulating, keeping the mind-body connection in balance. When a threat is no longer evident, hormone levels decrease. As adrenaline and cortisol levels drop, heart rate and blood pressure return to baseline levels, and other systems resume their regular activities.

But when stressors are always present, adrenaline and cortisol levels remain high, causing unwanted or unhealthy results, such as:

- Exhaustion
- Physical pain
- Lack of concentration
- Memory problems
- Anger
- Sleep problems
- Aggression

Over the long-term, high cortisol levels can also suppress the immune system, reduce resistance to allergies, cause impaired cognitive function, and affect an individual’s feelings of failure, anxiety and depression.

**Post Traumatic Stress Disorder**

PTSD becomes potentially a disorder of memory in that a traumatic event leads to a memory that leads to cognitive symptoms.

Children need structure and enrichment to help them self-regulate.

- Self-regulation is related to the child’s capacity to tolerate sensations of distress such as hunger, frustration, and fatigue.
If the child’s amygdala is over-reactive, the child has less ability to tolerate distress and is more impulsive and reactive, less able to put space and time between feelings and action.

When the child has less ability to self-regulate, the child is less likely to think and plan and is more disruptive, more over-reactive to slight changes and challenges, and more hypersensitive to transitions.