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facts on

# Brain Development and Young Children

**Is the brain fully developed at birth?**
No. The hindbrain, including the brain stem, is the only area of the brain that is almost fully developed at birth. All of the brain structures are in place at birth but not fully developed in size and function. The early years (0-6 years) are a critical period for brain development. In fact, by four years of age, a child's brain is already 90% of the size of an adult's brain.

**Why are the early years important for brain development?**
There is rapid growth and development of the brain during early childhood. At this time, parents and caregivers have an opportunity to impact brain development. This is also a time when the brain is the most vulnerable.

**How does the brain communicate between different areas?**
Communication within the brain is called neurotransmission. It takes place using neurons (nerve cells) and neural networks (connections between neurons). There are over 100 billion neurons in the brain. Many neurons and neural networks are already formed by the time a baby is born, although some are added after birth. Although many neurons already exist at birth, they are not connected in any meaningful way that allows for "communication". Neurons communicate with each other through electrical stimulation that passes from one neuron to another.

In order to facilitate communication, neurons connect together to form neural pathways and networks.

**How are neural networks formed?**
Neurons that are stimulated together form connections (i.e. "neurons that fire together wire together"), and these connections develop into networks of interconnected neurons. These networks are developed and reinforced in a "use-dependent" fashion. The repeated stimulation of neural networks, through similar experiences, reinforces or strengthens them. When neural connections are not reinforced, they "die" off or "fade away". This process takes place in early childhood and the networks strengthened are based on repeated experiences the child has, e.g. if a child has frequent positive interactions, his brain will become 'wired' to perceive, interpret and respond to positive interactions.

Newborns begin to develop neural networks through spontaneous activity (e.g., sucking reflexes for feeding). Later, networks are formed and strengthened through repetitive experiences (e.g., if a child has frequent positive interactions, his brain will become 'wired' to perceive, interpret and respond to positive interactions). Consistent caregiving is one of the most important avenues of repetitive, positive experiences available for very young children. Stimulation through repetitive experiences, such as, listening to their mother's heart beat, rocking, hearing soothing sounds and caregiving routines all help to build neural networks.

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**What are some basics about brain structure?**

Although the brain is a complex system of interconnected parts, the functions of these parts can generally be identified by their location in the brain. That is, different areas of the brain are responsible for different functions. All of these areas interact together to allow the brain to work as a whole system. The following table presents some basic descriptions of brain structures.

| Structure | Image | Description |
|---|---|---|
| **Forebrain** ***(Highest Region)*** | | • the largest part of the brain<br>• includes the cerebrum, thalamus, and hypothalamus<br>• the main control centre for sensory processing, voluntary motor functions, and higher intellectual functions<br>• Hypothalamus regulates homeostasis of body systems such as body temperature, blood pressure, hunger and thirst, and links the autonomic nervous system to the endocrine system |
| **Midbrain** | | • located at the top of the brain stem<br>• contains centres that receive information and then make sense of it (e.g., relays sound/auditory and visual information)<br>• contains the limbic system involved in many of our emotions and motivations, particularly those related to survival and memory |
| **Hindbrain** ***(Lowest Region)*** | | • contains the brainstem, pons, medulla oblongata, and the cerebellum<br>• acts like the body's computer by regulating the automatic processes of the body (e.g., breathing and swallowing) and the stress response system |

**How does the brain develop?**

The brain develops in a sequential and hierarchal fashion starting from the lower regions (hindbrain) and working its way up. Picture this as a pyramid with the lower regions as the base. If the base is not properly developed, the whole structure will be impacted.

Not only can the function of the brain be affected during early childhood, so too can the actual structure of the brain. Children who are abused or neglected have been shown to have smaller brains and other structural differences compared to the brains of children who come from positive caregiving backgrounds.

**If the brain does not develop properly in early childhood, can it still be "fixed" later on?**

The answer to this is no and yes.

Brain structures that are underdeveloped in childhood or whose structures have been impacted by stress related chemicals will probably not be able to be what they would have been if they had not been impacted.

However, neural systems are plastic (adaptable). Neural-networks can be changed. This can be a lengthy process and some systems are easier to change than others. Change is easiest at an early age, but still possible later in life. Change to neural networks must occur in the same order that development normally does and therefore it is important to start with the lowest areas of the brain.

For example, if a neural network has been formed that interprets raised hands as a threat and therefore causes a child to flinch anytime people raise their hands in class, the child must first be taught how to soothe and ground themselves before learning that people will not hurt him. This is because the stress response caused by the hands happens in the hindbrain. Once this is triggered, information will not go to the higher areas of the brain where reasoning can take place. Therefore, a neural network must be created and reinforced that teaches the child to "turn down" or "turn off" the stress response.

**How can caregivers help their child's brain develop optimally?**

- Love your child no matter what they do or say (unconditional love)
- Learn behaviors that will promote secure attachment
- Provide safe, appropriate touch through cuddling, hugging, holding, feeding, and rocking
- Respond to their child's needs in a consistent and sensitive manner
- Create routines for day-to-day activities
- Provide consistent care
- Follow their child's cues regarding when to be stimulating and when to be calm
- Provide new experiences and environments to safely explore
- Praise their child, being specific about what you are praising him for and why
- Set boundaries and rules and reinforce these in a kind, calm and respectful way
- Encourage play
- Speak to your child in a positive way
- Talk about what they are doing and how they are feeling
- Encourage the child to learn words for their emotions
- Provide opportunities for rhythmic listening and movement through music and movement
- Remember that repetitive play, movement, sounds, phrases, and songs all help develop the brain

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