SMART Early Years

Discussion Paper 1

Understanding brain structures in responding to trauma

Introduction

This discussion paper is one of a series designed to generate discussion and share knowledge and experience. It also provides a series of critical questions to further enhance responses to young children who have experienced trauma.

One of the central platforms of understanding in the SMART program is the knowledge of how trauma affects the development and functioning of children's brains. While brain development is extensively covered in the face-to-face workshops and the online training, this paper seeks to extend the reader's understanding of key parts of the brain, their function and the changes caused by experiences of relational trauma.

Section 1. Understanding the development, function, and impact of trauma on various parts of the brain

The human brain is an amazing organ. It defines who we are and guides us through our life. The brain's primary function is to integrate sensory data to enable the individual to adapt successfully to their environment.

In order to do this, the brain must:

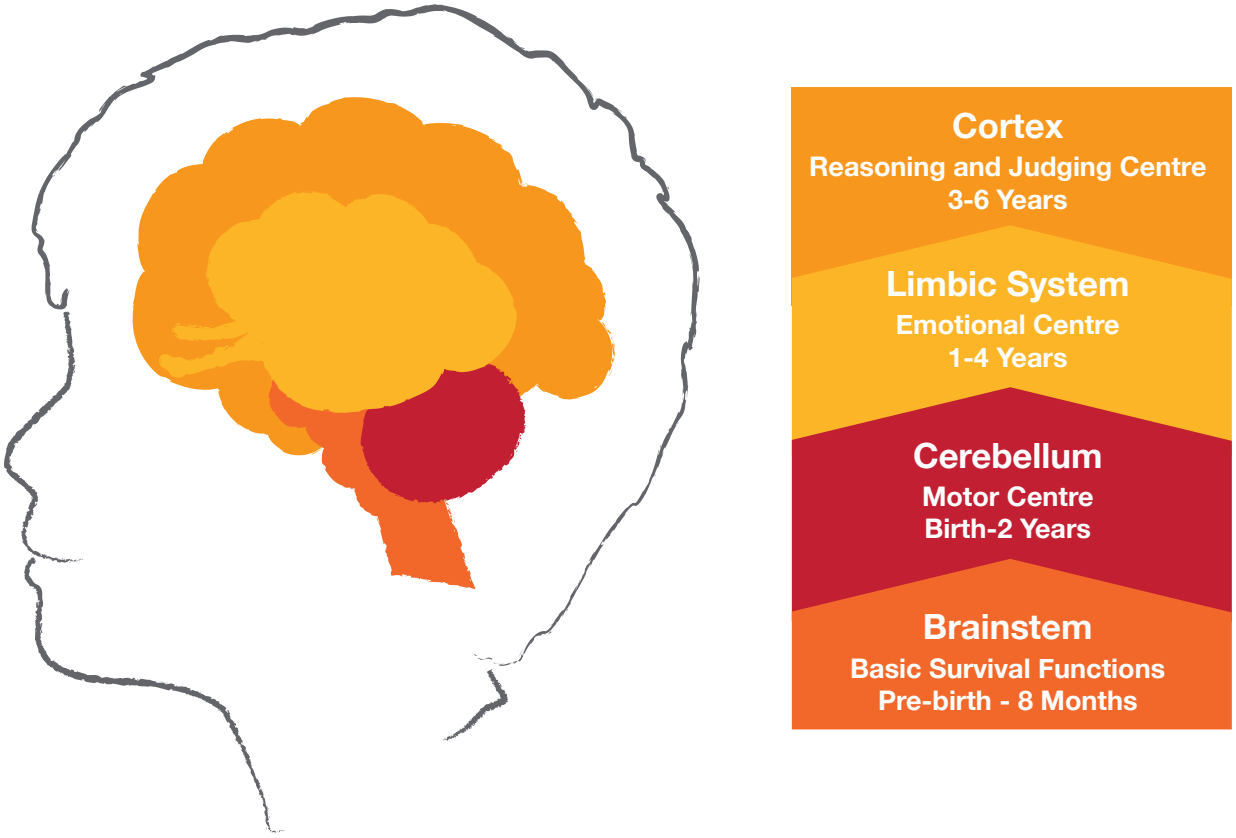
SENSE Detect sensory information from our external environment and our internal world.

PROCESS The incoming data and communicate it to the rest of our body.

STORE Retain information for future use.

ACT Coordinate a response, behaviourally and physiologically, to the information and to adapt as needed for the environment.

Brain development begins in utero and undergoes a rapid period of growth in the first 3 years of life.



Trauma can impact on all aspects of a child's development, understanding these impacts is critical to identifying what support traumatised children need. Sequential brain development is significantly disrupted by developmental trauma and toxic stress. Many areas of the brain may be underdeveloped, whilst other areas may be over-active. Regions of the brain may be poorly organised and the connections between the regions less efficient. Horizontal integration, the connection between the left and right hemispheres may also be reduced, as the corpus callosum, the bridge structure between the hemispheres has been found to be smaller and act slower. This may present as taking longer to hear and process information and taking action.

Brain Development & Trauma

Brain development begins in utero, starting with the brainstem.

The brainstem is connected to the spinal cord and is responsible for basic functions that keep us alive (heart rate, breathing, blood pressure, sucking reflex, swallowing). The brainstem also regulates our physiological states (sleep, appetite, oxygen and sugar levels). The brainstem is fully developed by birth, continuing to be fine-tuned in the first few months of life. It is the part of the brain that is 'hard wired' and least susceptible to change.

A brainstem impacted by trauma may results in

- Increased baseline heartrate
- Sleep difficulties
- Shallow breathing
- Overactive response to visual threat stimuli
- Dysregulation

Connected to the brainstem is the cerebellum or motor centre of the brain.

The cerebellum develops throughout the first two years post-birth. It helps us to know where our bodies are in space, support our posture, movement and balance. The cerebellum's development can clearly be seen in the early years of a child's life as they gain head control, sitting, crawling and walking. In the next few years gaining greater co-ordination learning to draw, cut, eat with cutlery, skip, kick a ball and ride a bicycle.

A cerebellum impacted by trauma may result in

- Decrease in volume
- Poor motor control and coordination
- Delay in fine and gross motor milestones

Moving up the brain from the cerebellum, you find the limbic system, or the emotion centre of the brain.

The emotion centre of the brain rules the lives of young children up to around four years of age. During the toddler years, the limbic system goes through a period of rapid development. This helps explain their bursts of irrational behaviours and big overwhelming feelings that we often see at this age. The way that children learn about their emotions is by experiencing the feelings and being supported by a regulated adult.

The limbic system is made up of the amygdala & hippocampus. The amygdala is often referred to as the "smoke detector" of the brain due to its central role in the detection of threat. The amygdala is active from birth and is highly responsive to sensory input, particularly those from other humans. When it senses danger, it quickly recruits other parts of the brain and body to respond.

The hippocampus is involved in the formation of explicit memories, it stores experiences with the context which facilitates their storage into long term memory. The hippocampus is then able to retrieve memories from long term "storage" as required because they have been stored in a clear place based on their context. Contextual information includes time, location and the events leading up to and following an experience.

In order to consider this contextual information in a short-term memory episode, think about the process you use to try to remember why you walked into a room in the house when you can't. You retrace your steps (time) back to the room you were in (location) and then think about the thought sequence you had entered into (events leading up to the experience).

Traumatic memories are encoded without this context because they are not stored explicitly (or with our conscious awareness). The hippocampus encodes the experience implicitly and without that linking information that marks this as a discrete, episodic memory. This means that recall as a whole becomes much more difficult.

Young children up to the age of 5 years are developing in the limbic lobe. They are very much governed by their emotions. They have big feelings about what is going on in their lives and their world. They do not have much cortex development as this part of the brain develops later.

A limbic system impacted by trauma may result in

- The amygdala may be larger, overactive and more sensitive to perceived threats or switched off
- Over-developed pathways between the thalamus and amygdala
- Underdeveloped pathways to the cortex
- Damage to the hippocampus, presenting as difficulties with memories.

The Cerebral Cortex is the last part of the brain to develop.

Young children under 5 start to develop some of their cortex but usually remain in the limbic lobe. The Cerebral Cortex is the largest part of the brain and is responsible for higher-level thinking, reasoning, and conscious processing. It stores explicit memories about events, people and experiences. The cortex, or the thinking part of the brain, is the last part to develop. This is the part of the brain responsible for reasoning, planning. This is the part of the brain that enables humans to think before they act. As children grow and develop, the cortex is gradually able to help us to pause when we are flooded by strong emotions, thus allowing us to feel, think, then act.

Unlike the brain stem, the limbic system and cortex are highly susceptible to change due to experience and the environment in which the child lives.

A cortex impacted by trauma may

- Goes “offline”
- Executive function diminishes (problem solving, impulse control, reflective capacity)

Questions for reflection or discussion

This paper informs the reader on the increase of functional awareness of brain structures and the roles and impact of relational trauma on that capacity. The following series of questions ask the reader to consider what this understanding might add to your work supporting children who have experienced chronic trauma.

1. How can this information about the brain and the impact of trauma support you in your work with a child?
2. How might this information about brain development and the impact of trauma support you to understand behaviours and or learning challenges you may experience with a child you support?
3. With many of the children you support being under 5 years of age, with their limbic system growing and developing, how might your understanding of brain development support you to understand the whole child?
4. Which SMART PRACTICE elements would be most relevant in supporting the child you are working with?