SMART Strategies for Managing Abuse Related Trauma

Discussion Paper 5

Extending our understanding of the role of specific brain structures in responding to trauma

Introduction

The intent of this paper is to generate discussion. The paper provides an opportunity for readers to share specific knowledge. It also poses a series of critical questions to further enhance responses to students who have experienced chronic traumatisation.

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 chronic abuse related trauma. The specific brain areas to be discussed in this paper are:

- **Thalamus**
- **amygdala**
- **Hippocampus**

Section 1. Understanding the role and function of the thalamus, amygdala and hippocampus

Thalamus

The thalamus is the sensory gate-keeper of the brain. It is connected to all parts of the brain- cortex, limbic lobe, midbrain and brainstem. The thalamus assesses the constant sensory data being received by our body and brain and then directs it to the appropriate area of the brain.

An example (non trauma related): Swimming

It is a lovely day and I have decided to go swimming at the beach. As I dive into the water, my senses send a range of data to the thalamus. This might include the cool feel of the water on my skin, the taste and smell of salty water and the air just above, the sound of the water as I dive into it as well as the sights associated with this environment. It would also receive data regarding my heart rate and blood pressure - the state of my body. All of this information would come into the thalamus as separate, discrete, pieces of information.

The thalamus would process much of this data as “bound” experience - all the elements are connected together. It would send the data to the to the cortex, via the **hippocampus**, which would enable a conscious experience of this event as a pleasant activity and happening at this present moment.

The primary role of the thalamus is to receive and connect sensory and arousal state information to send to the higher parts of the brain.

An example (trauma related): Witnessing domestic violence incident

I am an 8 year old girl who is watching my mother being thrown against a wall by my father. As I watch this my senses send a range of data to the thalamus. All of this data is overwhelming in its intensity as I hear my father yell abuse, see the impact of the violence on my mother, smell fear as my heart rate and blood pressure increase significantly. All of this information comes into the thalamus as separate, discrete, pieces of information but each with an overwhelming spike of intensity. The thalamus is so inundated by this data it cannot “bind” the experience and will usually direct it all, still separated, to the **amygdala** - the fear response centre of the brain. It will also shut the cortex down so it cannot be overwhelmed by this experience so there is a lack of conscious encoding- a key element of the trauma response continuum. This means there is a disconnection between the experienced state of this incident and conscious awareness of this state in the moment and at any future time this state response is triggered or activated.

It is because of this process that children’s traumatic memories are often experienced as timeless, vivid sensory fragments stemming from the original, overwhelming, experience.

Amygdala

The amygdala (situated in the limbic area of the brain) is the fear response centre of the brain. It is responsible for evaluating threat and danger. It tends to make this assessment based on blocks of data, ie: large volumes of data rather than specific nuances of information. This is reflected in the fact that there are more pathways out than into the amygdale. For example, this means it cannot differentiate between a real or perceived danger as the neural pathways into it are triggered by both. The amygdala has strong connections to the **medial prefrontal cortex** and to the brain stem- enabling it to release one of the stress hormones, acetylcholine, when required.

Non trauma related example: Walking home

I am walking home from the train station and there is someone behind me who seems to be following me. The amygdala receives a flow of information - being passed on by the thalamus - that activates a fear response. It sends a message to the medial prefrontal cortex which is primarily responsible for suppressing stress hormones and regulating my response. I continue to walk but am conscious of the person behind me. Because my cortex is not overwhelmed by this fear response I begin to plan my options - will I run, will I walk into a house with the light on, will I use my mobile phone or just stop? I am experiencing some physiological fear responses too though - my heart is beating very fast, my stomach is churning and I feel a bit sweaty. The person behind me walks into their house I begin to down regulate my responses - using a range of cortically based strategies.

The amygdala has interpreted a danger very quickly through input from the lower parts of the brain. It is critical to responding to threat to recognize it even before we are consciously aware of the danger.

Trauma related example: Experience of emotional abuse

I am a 7 year old boy and I've lost count of how many times my mother has called me a "worthless thing" and yelled, "my life would be so much better if you'd never been born." Even though these are verbal exchanges, my amygdala is primed to respond to threat because it has happened so often. The sensory data received during this exchange sets off the amygdala's fear response again. This is particularly driven by a recognition of my mother's angry face.

Because of the repeated pattern of emotional abuse, the boy's amygdala could have developed one of two patterns of responding - either an overactive amygdala response or an underactive one. In the overactive response, the amygdala is always "on alert" so there is a constant, generalized, experience of fear. In the underactive response, the amygdala has been so overwhelmed it has shut down or switched off - leaving the child with a restricted mechanism to perceive threat or danger.

One of the outcomes of this impaired amygdala response for children who have experienced abuse related trauma is that they find it difficult to recognize the emotions other people are trying to convey with their face, voice and gestures. It is also the case that the amygdala works in conjunction with the **hippocampus** to try to store these fear memories. The fear is generalized when stored such that, in the previous example, any yelling voice - not just the mother's voice - becomes a source of the fear response.

Hippocampus

The hippocampus is a key component of our memory encoding capacity. 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.

Trauma also impairs hippocampal capacity because the constant flood of stress hormones has a significantly negative impact on this capacity. Research has demonstrated this reduction in capacity can be up to 25% of non-traumatised peers.

Section 2. Questions for reflection or discussion

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

1. Does the information about the thalamus, amygdala and hippocampus "fit" with a child or young person with whom you work?
2. What understanding of their behaviour or learning issues do you draw from the material included in this paper?
3. Which SMART PRACTICE elements would be most relevant in supporting the child or young person you identified based on this content?
4. How might you apply those elements in your work with that child?
5. Are there any other issues regarding the impact of trauma on brain development you would like to know more about?
6. Would you recommend other resources about this content to your colleagues?