The Neuroscience of Trauma

Trauma is the response to an event that overwhelms our ability to cope. It describes the challenging effects that living through a distressing event or series of events can have for an individual. Trauma may impact one's physical, psychological (emotional or cognitive), social, and spiritual health and well-being.

Defining a traumatic event can be difficult as the same event may be more traumatic for some people than for others. However, traumatic events experienced **early in life**, such as abuse, neglect, and disrupted attachment, can often be devastating. **Later life events,** such as experiencing violence, a serious accident, sudden unexpected loss, or living through a natural disaster or war can be equally challenging and traumatic (CAMH, 2022). Trauma can also result from intergenerational and historical acts, such as genocide, terrorism, and colonialism.

Events are traumatic due to complex interactions between someone's neurobiology, their previous and current experiences of trauma and violence, and the influence of broader community and social structures. The neuroscience of trauma can be seen in how people process and recollect memories, in the fragmentation or suppression of memories; how they perceive and interpret the world, in their ability to cope and their general health and well-being. It is important to remember that people can and do recover from trauma through one's natural process of recovery and healing. Whereas some people may need more time and require the professional assistance offered by mental health professionals, or they may develop unhealthy coping strategies.

The neuroscience of trauma ... in detail

When trauma is triggered for the person, either through reading a script describing what happened or when it is triggered by their environment, their body re-experiences the trauma again and the amygdala gets activated, triggering the fight, flight or freeze response. Adrenaline secretion increases, triggers the response, and consequently, their blood pressure and heart rate also get elevated. For people without a trauma history, after the event is over their body will settle down. Once the danger is gone and they feel safe, the increased levels of adrenaline will go back to normal.

For trauma survivors, the increased levels of adrenaline do not go back to normal levels. Their body takes much longer to come back to the baseline. They may not feel safe. With a trauma history, hormonal levels spike faster and disproportionately in response to mildly stressful conditions. This constantly elevated hormonal level can result in cognitive difficulties such as memory and attention problems, and sleep disorders for these individuals. For trauma survivors, the trauma may never end, and the body continues to defend itself long after. The function of the nervous system may be completely altered after trauma.

Trauma affects brain structures on many different levels; the neocortex, limbic system, and brain stem are affected. The neocortex, or rational brain, is the newer and high-functional level of the brain and includes the

prefrontal cortex ('PFC'), where we have our executive function system. People's ability to connect to others significantly depends on a well-functioning frontal cortex. In addition, metacognitive skills allow individuals to understand and realize that others may think and feel differently than them and have different motives, intentions, or values. This **ability to monitor and understand surroundings** is important because it helps people to distinguish safe versus unsafe environments.[1]

Moreover, the PFC has an **inhibitory role in preventing irrational behaviours**. It overrides impulses from the emotional brain to prevent inappropriate behaviours. Childhood adversity and trauma **disrupt the development of the PFC** and its connection to other parts of the brain such as the limbic system. The limbic system is the part of the brain responsible for emotions and memory. So, the limbic system is responsible for monitoring the environment to detect any sense of threat or danger to assure safety and comfort level and measure pleasure and pain. It is the primary command system that enables individuals to function in complex social situations. The limbic system, in coordination with a child's genetic makeup and temperament, sets the default setting of the emotional brain. The structures of the limbic system may not be as complex as the neocortex, but they have crucial roles in responding to danger as quickly as possible. When danger is detected in the environment, the fight, flight or freeze system gets activated, and the body reacts.

The amygdala, one of the most important parts of the limbic system, acts as the central commander of the limbic system and is responsible for processing emotions and affects. For trauma survivors, particularly those with repeated experiences of traumatic events, the amygdala gets over-activated. It becomes more and more difficult to predict when the danger is real. People with childhood trauma in particular experience more difficulties because their source of comfort, their caregiver, is often the source of danger.

Studies have shown how the amygdala overreacts when trauma survivors feel stress. A brain scanner in the laboratory has shown that when a survivor is presented with a picture of a person who is afraid, the corresponding reaction in the brain is visible. The activation level of their amygdala at baseline is higher than a non-traumatized person, indicating that the amygdala gets triggered much quicker in survivors. Over-sensitivity of the amygdala can result in misinterpreting danger and stressful situations. All these malfunctions in the brain are cemented into place in a way that can hold trauma survivors in a constant state of agitation and hyper-arousal. High emotional sensitivity prevents them from regulating their emotional states and returning to the baseline quickly.

Studies have indicated that some people who have experienced trauma have difficulty identifying and labelling their emotional state, a condition called alexithymia, which is usually followed by an intense level of emotional numbness. Alexithymia was found to be more likely for those who had experienced multiple traumatic incidents. These individuals may be unable to tolerate stressful situations and negative effects. Identifying and labelling what is happening in the brain and in the body can reduce the intensity of the emotional state. However, it can feel impossible to many people to step out of the situation and reflect on their feeling in order to handle distress. The resulting behaviour and choices can be difficult for others to deal with and can become a vicious circle of re-traumatization as service providers and supporters decide they cannot continue in a support role.

Reference

[1] Morgart, K., Harrison, J.N., Hoon, A.H., Jr and Wilms Floet, A.M. (2021), Adverse childhood experiences and developmental disabilities: risks, resiliency, and policy. Dev Med Child Neurol, 63: 1149-1154. ***www.doi.org/10.1111/dmcn.14911***