Mind over matter?
Exploring the impact of childhood trauma on the developing brain

They say the mind is plastic and that it's never too late to learn. Extensive research has been dedicated to uncovering the mysteries of the brain and how we can maximise our potential irrespective of age. But what if we consider the other end of the spectrum? After all, our brain begins its incredible journey of development as early as two weeks after conception [1]. We may not have the clearest, if any, recollection of our first years in existence, but there are a few key questions worth speculating upon. How much do our earliest experiences really impact our neurological universe? How do adverse childhood events affect a young person's ability to learn, adapt and thrive? And perhaps most importantly, what can we do to improve the prospects and outcomes for individuals who have lived through trauma?

Are our brains really stronger than our conditioning? When you contemplate the science of early cognitive development, you begin to appreciate the complex interplay of factors that contribute to how the brain is wired over time. These many variables play a pivotal role in how a child comes to understand and interact with the world around them and ultimately, how they find their own place in it.

The intricacy of the brain's design, paired with a vast amount of conditioning potential in the form of life experience, makes this organ one of great fascination for researchers. Neuroscientists and child development experts alike are studying the role of early trauma in shaping an individual's physiology and psychology, through in-depth investigations into brain structure and function. Their findings offer detailed insights into how cognitive development is inherently linked with our upbringings and environments – telling a compelling story about how our brains make us who we are.

Early childhood is a highly sensitive time when it comes to brain development. Babies are born with approximately 100 billion neurons, with an additional 250 000 to 500 000 neurons generated every minute during the first few months of life [2]. This neural matter becomes increasingly dense and interconnected with exposure to environmental stimuli [3]. Between birth and two years of age, the brain undergoes significant synaptogenesis, or rapid growth in the synaptic connections that enable neurons to communicate with each other [4]. This process, which occurs again during adolescence, plays a crucial role in generating the overall brain architecture [4].

As the brain continues its development, synapses are subsequently refined in a process known as neural pruning [5]. This phenomenon is based on which neural connections are most consistently used and is vital to a functioning adult brain [5]. It therefore follows that repeated exposure to a range of positive input and enriching stimuli during childhood is invaluable when it comes to promoting healthy brain development.

Unfortunately, the reverse effect is also true. Imagine a child, whose brain is already undergoing dramatic change, experiencing some form of trauma during this foundational period of their life. Violence in the home, neglect, abuse, mental illness, drug use, poverty. These are all examples of events collectively known as adverse childhood experiences (ACEs) [6]. It has been shown that excessive stress and ACEs can result in changes to the brain that have the potential to impact a child's behaviour and capacity for learning [7].

The concept that the environment in which an individual is raised plays a central role in their development, alongside hereditary factors, is commonly referred to as the nature versus nurture hypothesis [8]. An emerging field of medical research known as epigenetics builds on this idea. Epigenetics describes gene expression based on experience, whereby DNA accumulates chemical signatures in a process known as methylation [9].

In cases of childhood trauma, activation of the body's hypothalamic-pituitary-adrenal (HPA) axis is involved in the induction of toxic stress, whereby the release of stress hormones mediates changes in heart rate, blood pressure, metabolism and immune function [9]. At normal levels, these effects are intended to be biologically adaptive, with the goal of enhancing an individual's ability to respond to stress [9]. However, significant stressors such as childhood trauma can result in dysregulation of the HPA axis, increasing the risk of long-term adverse health outcomes [9].

Alteration of the HPA axis in response to adversity has been shown to exert an impact at the gene level [9]. In a 2017 systematic review of epigenetic associations with childhood trauma in first episode psychosis patients and healthy individuals, childhood trauma was associated with global hypomethylation in peripheral blood samples [10, 11].

Interestingly, research has revealed the effects of trauma can be passed down through generations via these epigenetic mechanisms [12]. These findings suggest the offspring of individuals who have faced trauma may endure 'secondary traumatisation' in the form of behavioural challenges such as anxiety, traumatic nightmares, dysphoria, guilt, hypervigilance and difficulties in interpersonal functioning [13].

This ultimately raises a pressing question: what can we do to break the cycle of childhood trauma, to best ameliorate its negative impacts and optimise long-term outcomes for both those who have personally experienced it and their loved ones?

Here we revisit the idea of neuroplasticity, but in this case consider its age-independent applicability. While the brain may reach full 'maturity' by our late 20s, adults exhibit a continued capacity to grow synapses, dendrites and supportive tissue through lifelong learning [14]. Studies have supported the use of creative expression, meditation and mindfulness in elevating resilience and reducing depression symptoms in people with a history of trauma [15]. Further research is also investigating the role of cognitive behavioural therapy in improving quality of life for these individuals [16].

It is never too late to reverse the impacts of childhood trauma. It may not be quite as simple as mind over matter – but while experiences may change the brain, healing can help rewire it.

References

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