RESEARCH SUMMARY

Early Adverse Experiences and the Developing Brain.
Bick, J. & Nelson, C.A.
Neuropsychopharmacology Reviews (2016), 41, 177-196.

This review is compiled from 184 papers and is up-to-date, thorough and comprehensive. It considers two groups of children: 1) those who have experienced childhood abusive maltreatment, and 2) those who have experienced extreme neglect by having been brought up in institutions. There is a large body of evidence that shows that these early adverse experiences are associated with cognitive problems and atypical emotional development. Slowly, evidence has accumulated to show that there are concomitant structural and functional changes in the brains of these children. This evidence has led to the realization that there is a serious public health concern associated with early adverse experiences in childhood.

The human brain has a complex development in early life. It does not simply expand to fill the space available in the skull; separate parts of the brain develop in a hierarchical manner at different times. This means that distinct adverse experiences can affect the brain differently at various times. The human brain begins to develop the brain stem around two weeks from conception, and reaches maturity in the third decade of life. However it is in the first three years of life that these two adverse experiences (abusive maltreatment and extreme neglect) begin to have their effects. The most complex structure involved in childhood adversity is the pre-frontal cortex, which is the region of the brain lying just above the eyes.

Two principal factors affect how the brain is developed: firstly genetic processes impose limits on its development, and secondly experience of the child's environment can shape the plasticity of the connections between the brain's nerve cells. Experience affects the connections between nerve cells to develop and fine tune the developing brain's networks and pathways. Good nurturing of the child enables the brain to reach its optimally determined genetic potential. Conversely, adverse experiences in the sensitive growing period lead to poor network connections and sub-optimal brain development leading to problematic outcomes.

Childhood abusive maltreatment
Maltreatment in the family setting reduces the global brain volume. Recent research shows that the specific regions that are affected by reduced volume are: the amygdala, responsible for emotional processing and stress regulation; the prefrontal cortex, which develops slowly over time and is responsible for executive functions and stress; the cerebellum, which is involved in learning and cognitive functions; and the corpus callosum, which is the largest white matter tract responsible for neural transmission across the cerebral hemispheres. Not surprisingly, the changes in volume of regions of the brain have consequences on brain function.

Much research has been carried out using functional Magnetic Resonance Imaging (fMRI) to determine the consequences of childhood abusive maltreatment. This non-invasive technique identifies brain regions that are activated by, for example, emotion processing and stress regulation. It is ideally suited for establishing brain activation differences between abused and non-abused children; the non-abused children act as a control group. Triggers for fMRI changes can be evoked by showing the participants photographs of threatening or emotional faces, or angry voices. Increased levels of amygdala activation are found when such images are shown.

Childhood neglect through institutional rearing

The fall of the Ceausescu regime in Romania (1998) led to the discovery of orphanages where a vast number of orphans were living in a state of serious neglect. The international response to the plight of the Romanian orphans led to large numbers of orphans being adopted. This response has enabled clinicians to monitor the ability of the orphans to recover from severe neglect after placement in a foster family. The on-going study is known as the Bucharest Early Intervention Project (BEIP).

It became clear that the children's brain volumes were significantly reduced compared with those brought up in a family environment. The reduction in amygdala volume was related to the time spent in the institution. Changes to the frontal cortex were most marked with significant decreases in volumes of cortical grey (75%) and white matter (67%) in the institutionalised children compared with never-institutionalised children (the control group100%). After fostering there was no improvement in grey matter volume, but the white matter increased to 80% of that of the never-institutionalised children.

The effect of fostering has been shown to improve alpha wave activity of the functioning brain if children were fostered before 24 months of age. Their alpha wave activity was similar to that of never-institutionalised children. (Alpha waves are picked up on the surface of the skull using electroencephalography (EEG). They occur when we are relaxed with closed eyes). However, if fostering occurred after 24 months, there was no improvement. This suggests that early intervention and fostering is probably the best strategy for improving cases of childhood neglect.

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