

The importance of experience prenatally and in the first two years of life: the impacts of trauma and maltreatment on neurobiology

In his first of two articles in the last issue **Daniel Isaacs** focused on the relationship between early normal or desirable experiences and subsequent neurobiological and biochemical development. Here he explores the impact of traumatic experiences on neurobiological development in these formative years, and subsequent implications for the developmental trajectory of the young child.

Trauma, Maltreatment and Biology

Infants that experience trauma and maltreatment are often found to have a myriad of emotional, social and cognitive difficulties¹. Such maltreatment is associated with disorganised attachment²; a fourth attachment category that is characterized by an inconsistent pattern of relating: approach, avoidance, and freezing. The parents are often the source of this confusion and fear due to inconsistent and frightening behaviour³. Research is now making links between these experiences and underlying biology.

In evolutionary terms, we are primed to respond to situations that pose serious threat. We employ the fight, flight or freeze strategies, all of which are reliant on biological systems. In fight or flight our hormonal system is ready to release adrenalin and cortisol into the blood stream in milliseconds, increasing our heart rate and blood pressure. This leads to a highly activated sympathetic nervous system which results in a constant state of hyperarousal⁴. Alternatively, other experiences recruit an over activation of the parasympathetic nervous system. This results in a shutting down of the body, a lowering of the heart rate and blood pressure, and deactivation of

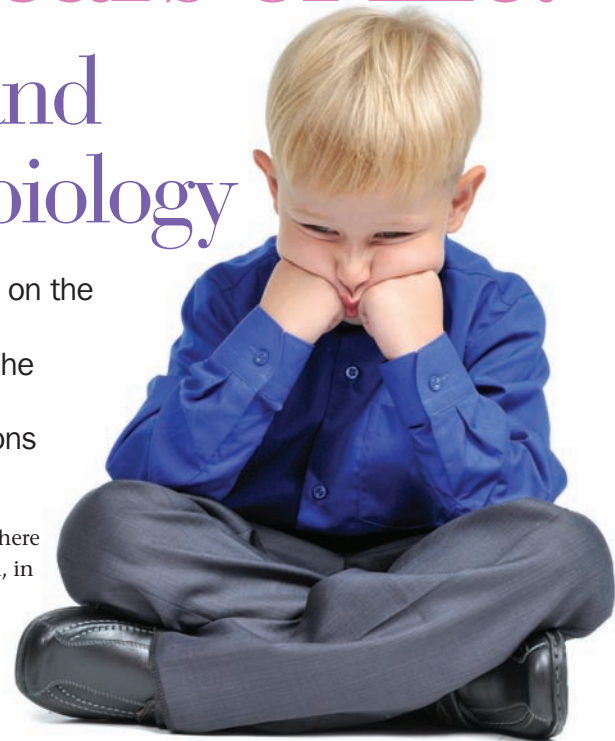
certain brain regions. There is a state of dissociation, in which there is no reaction to traumatic stimuli^{4, 5}. Similarly we may also freeze, as if playing dead.

These evolutionary responses to traumatic experiences are associated with activation of the amygdala, via the thalamus, which results in the almost instant response (the fast route)⁶. The amygdala is responsible for storing unconscious emotional memories and abused children show increased activation of the amygdala, but decreased activation of thinking regions, and regions responsible for putting feelings into words⁷. Normally speaking, once the threat has passed, we return to a normal state of functioning. However, some people do not⁸.

Trauma

The hyper-vigilant child has higher levels of cortisol, which can result in cell atrophy and inhibition of new cell growth in the hippocampus^{9, 10}. The hippocampus plays an important role in down-regulating the adrenal glands, reducing adrenalin, and decreasing arousal¹. Therefore if the hippocampus is compromised this may result in a vicious cycle in which a normal state of arousal is not achievable.

Reduced hippocampal size has also



been to found to predate traumatic events, suggesting a neurophysiological predisposition to respond to trauma in this way. In a twin study Gilbertsen and colleagues¹¹ found that some twins have an abnormally small hippocampus, even when only one is exposed to trauma and is suffering from Post-Traumatic Stress Disorder (PTSD). They suggested that a small hippocampus is a risk factor for the development of PTSD, and that subsequent trauma is needed to switch on this risk factor, i.e. those with a smaller hippocampus find it harder to process trauma. It is also important to keep in mind however, that the twins in this study may have had smaller hippocampi as a result of early childhood stress. It is not simply a case of genetic inheritance or environmental influence, but the interaction between nature and nurture.

Abuse: neglect and maltreatment

In a sample of institutionalized children aged between 6 and 30 months

who had experienced psychosocial deprivation, there was a significant reduction in the cortical thickness of a vast number of regions involved, including the orbitofrontal cortex, possibly due to pruning¹². Furthermore, the authors found reduced cortical thickness to be associated with an increased risk for Attention Deficit Hyperactivity Disorder (ADHD), indicating an association between the experience of early social deprivation, concomitant structural changes in the brain, and the development of psychopathology. As shown by the Robertson films¹³, infants who experience social deprivation often end up in a dissociated state in which they are cut off from the world. This matches the parasympathetic response to trauma, which is linked to Le Doux's⁶ fast route and a switching off of the thinking part of the brain⁸. We can see how in a setting such as the school classroom this may present more like inattention, and raise the question of ADHD. More investigation would be needed, but this may link to the findings of McLaughlin et al¹².

Taking another perspective, psychoanalytically this dissociation can



early childhood, the greater the degree of activation in the amygdala. This finding has been replicated in adults¹⁷, and indicates a developmental trajectory towards difficulties in later life, as a result of the experience of abuse, and its associated effects on the brain. This is corroborated by research indicating a link between maltreatment, amygdala activation and the development of such psychiatric disorders as depression, anxiety disorder and PTSD¹⁸.

Such research, whilst pioneering, is in need of replication before firm

these articles comes from European or westernised populations, and so extrapolating findings to other societies and cultures may not be valid or reliable. Therefore it is vitally important that we keep culture at the forefront of our minds when considering research findings. To fully understand the nature-nurture interplay between prenatal and early experiences, culture, and biology, an increase in culturally diverse research will be necessary.

Conclusions

It is clear to see that maltreatment,

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be thought of as a defence that results in the child cutting off from the external world and thus suffering more internally due to a lack of engagement with others, even those with good intentions. This is known as double deprivation¹⁴

McCrorry et al¹⁵ found that when children that had been exposed to familial violence were presented with angry faces, there was a significant increase in amygdala activation. They also found that these children had no conscious awareness of their increased arousal in response to angry stimuli. This suggests that children who have experienced abuse may have no awareness of the moments or triggers that lead to heightened arousal later in life. This provides insight into some of the behaviours that are seen in these populations (i.e. fear or anger), and again links back to the idea that the 'thinking' brain is switched off and Le Doux's⁶ fast route is being taken.

In a later study McCrorry and colleagues¹⁶ found that the longer emotional abuse had been suffered in

conclusions can be drawn. However, research supports the association between early experiences of trauma, neglect and maltreatment, consequent changes in brain structure and function, and the development of emotional, social, and behavioural difficulties and psychopathology. This highlights the importance of experiences prenatally and in the first two years. Detrimental experiences can have severe consequences for later life.

Cultural Considerations

The environment in which the foetus and infant develops can vary greatly in different societies, leading to differences in normal brain development and subsequent cognitive, emotional and behavioural development (Music, 2011). For example, some cultures value an independent autonomous baby (egocentrism) and some believe that the baby needs to be surrounded by interdependent relationships (sociocentrism)¹⁹.

The majority of the research cited in

trauma and neglect prenatally and in the first two years of life have a significant impact upon our biochemistry and neurobiology, and subsequently on the developmental trajectory.

The combination of early experiences, genetic potential and our biology is a powerful one. When nature and nurture interact for the better the developing infant can flourish, however when they interact for the worse the impact can be profound. However, it should be borne in mind that such early experiences do not condemn a developing child to the proverbial scrap-heap. We are shaped by early experience, but not defined by it. With subsequent good experiences, socially and in terms of attachment relationships, some of these children can flourish.

Moving forwards, culturally informed and methodologically sound research has a vital role to play in helping us understand the environmental and biological mechanisms that are important in foetal and infant development.

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