

neglect and the developing brain...



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Over the last twenty years, strong evidence has emerged regarding the association between child maltreatment and neurological and neurodevelopmental effects. Previously, a strong focus was made of the effects of non-accidental physical abuse, sexual abuse and the effects of witnessing traumatic incidents. However, the most recent evidence alludes to the often unrecognised, insidious effects of neglect. The effects of neglect are not only psychological but neurological both in the structure and volume of the brain itself and the efficiency of its multitude of connections. In this article I will give a brief summary of the effects of neglect on the development of the child and how particularly intentional or unintentional neglect early in life can have serious consequences for their physical, psychological, cognitive and intellectual development.

Glaser (2000), defined child abuse and neglect as preventable phenomena that affect the survival and development of the child. Child abuse and neglect are not predicated on an intention to harm the child and must be at a level which would be considered outside of the normal and usual interaction one would expect. The Australian Institute of Family Studies defines child maltreatment as any "non-accidental behaviour by parents, caregivers, other adults or older adolescents that is outside the norms of conduct and entails a substantial risk of causing physical or emotional harm to a child or young person. Such behaviours may be intentional or unintentional and can include acts of

omission (i.e., neglect) and commission (i.e., abuse)."

Child maltreatment is divided into five main subtypes: physical abuse; emotional maltreatment; neglect; sexual abuse; and the witnessing of family violence. Neglect refers to the failure by a parent or caregiver to provide a child (where they are in a position to do so) with the conditions that are culturally accepted as being essential for their physical and emotional development and wellbeing (Broadbent & Bentley, 1997; Bromfield, 2005; WHO, 2006). Neglect encompasses physical neglect, emotional (or psychological) neglect, educational neglect and environmental neglect (Dubowitz, Pitts, & Black, 2004).

Over the last twenty years strong evidence has emerged regarding the association between child maltreatment and neurological and neurodevelopmental effects. When considering this literature one should be mindful of the concepts of multi-finality and equi-finality. Multi-finality suggests that different children may undergo similar experiences but those experiences will affect them psychologically and biologically in different ways. Whereas equi-finality suggests that the psychological and neurological consequences of an event will be exactly the same for every child. One should be mindful of these differing concepts when discussing the literature. The research often talks as if the findings are equi-final. In other words, that every child will follow the same developmental trajectory if these certain events do or do not occur. The reader should be mindful that this is not always the case and that multi-finality must always be considered. Two children may endure the same levels of neglect but this will often affect them and their development very differently. Therefore when reading this article remember that suggestions of reliable causality may be misplaced.

Other things to consider regarding any kind of abuse and its effects on the victim are the characteristics of the abuse itself. This would include the severity, frequency and chronicity, all of which affect the outcomes. The child's characteristics are also vital to influencing outcomes. These include the child's age, gender, temperament, level of physical, developmental or intellectual disability all affect their level of vulnerability which may influence the kind of abuse suffered and the nature of its effects. Finally the characteristics of

the abuser themselves will influence outcomes. Whether they have been abused themselves, their socio-economic status, physical health, and the family or home context are all factors to consider.

Myers *et al* (2002) reviewed longitudinal studies of emotional neglect by parents who were typically emotionally unavailable. These children during high school years were often found to be socially withdrawn, inattentive, and had lower cognitive abilities. In school, they were also found to be underachieving compared to their peers. Weinberg and Tronick (1998) investigated the effects of maternal depression and found that the children were often compromised in their behavioural, cognitive and emotional functioning. Detrimental effects were found to remain long after the mother's recovery.

“Severe deprivation and neglect in the first five years of the child’s life results in global disorganisation and development of the brain...”

Glaser (2000) reported that the process of early brain development is constantly modified by these environmental influences. Child abuse and neglect present the developing brain with experiences that potentially adversely affect the child's current and future functioning. The younger the child the more these environmental factors are mediated by the caregiver. At the centre of this are neurotrophins which are chemicals in the brain vital for the creation and maintenance of neurons which are responsible for transmission and receiving of information around the brain. Neurotrophins are dependant on neuronal activity which itself is dependent on environmental input. Therefore, it is suggested that while the brain and neurons get into place automatically their ability to develop, work, interconnect, and function is directly related to the child's environment.

During first 2 years of life there is this sequential growth in the brain as synapses and connections are made. This is a competitive process where survival of these synapses and connections is dictated by use. This is where the environment and its potential to cause permanent

neurological damage comes in. Absence of the usual experiences associated with love and attachment can contribute to the failure of many synaptic connections being made. Perry *et al* in 2007 found that severe deprivation and neglect in the first five years of the child's life results in global disorganisation and development of the brain. Some such children have been found to have enlarged ventricles and Atrophy.

Bateson (1979) described this competition and need for environmental influences as a 'Brief Opening' of a "Window of Need" which exists both in animals and humans. Greenough & Black (1992) said that these external events that dictate our neurobiological developmental functioning can be categorised into two levels of priority. "Experience Expectant" experiences are those events that have to happen. This is development that will not take place unless particular experiences occur during predetermined critical periods. For example, infants learn self-regulation and arousal levels when new stimuli is presented to them in a way that is "safe, nurturing, predictable, repetitive, gradual and attuned to the infant or child's developmental stage's" (Perry *et al*, 2007). Such experiences also include being handled, developing a responsive gaze, and being spoken too. Therefore, experience expectant events are predetermined stages of interaction that the caregiver must give the child if their neurological, psychological and cognitive functioning are going to develop to at least a basic standard. Importantly, if one stage is missed it can have a knock on effect in further development.

Further synaptic growth can develop if experiences over and above basic care are then offered. Greenough and Black (1992) describe these as "Experience Dependent" experiences that might be advantageous to further development. An example might be teaching your child to play the violin at an early age. This experience isn't vital to the child's basic development but is certainly advantageous. To further demonstrate this Greenough and Black discuss studies where rats weaned in a complex group environment had 25% more synapses per neuron than those who just experience basic care.

Therefore, care giver interaction is vital to the child's development. This is no more important than in developing well regulated levels of arousal and self-regulation. This is vital in the infant being able to



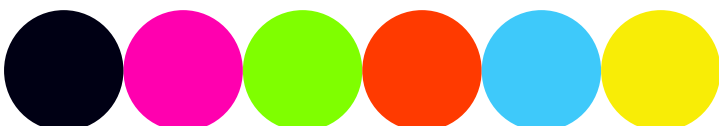
experience and enjoy pleasurable activities. The role of the caregiver is to modulate displeasure, for example, calming the infant after a traumatic incident, so that the child develops a model of the world as safe and predictable. Courchesne *et al* (1994) reported that in studies of depressed mothers who were withdrawn and disengaged from interactions with their children, the child brain was often unable to self-regulate affect. Due to the closure of the critical periods discussed earlier, the possibility acquiring these abilities later in life, once the mother recovered, was also found to be very limited. Courchesne reported that "misconstruction" was often found to be "completed".

Attachment behaviour such as this is defined as proximity seeking behaviour by the dependent infant when he/she experiences discomfort. The parent's role should be to reduce discomfort and give the child love and protection in a safe and predictable environment. The child develops an internal model of the self, the parent, the world and the predictability of life. Gunnar *et al* (1996) said that the role of attachment is to buffer the potential ill effects of over production of glucose in early years which can cause brain damage. Izard *et al* (1991) even found that there is a complex relationship between attachment and other biophysiological indicators such as cardiac functioning. Rats exposed to prenatal stress demonstrated long lasting symptoms of hypertension. In humans this would increase the risk and severity of any cardiovascular disease (Neigh *et al*, 2009).

ing stressed or agitated states and is the so-called "stress hormone". It acts to dampen the fear response and to prevent overreaction to fear. Cortisol also serves to increase glucose levels. Fear messages come from the amygdala and hippocampus with direct links to the brain stem for heart and blood pressure rate adjustment. Children with low stress thresholds are particularly vulnerable when they have insensitive or punitive caregivers. Shields *et al* (1994) found that children exposed to repeated stress led to suppression of the stress response and reduced cortical activity. This can explain the passive fear which is often seen in children who have suffered long-term abuse. In 1998 Gunnar conducted a famous experiment where cortisol levels were found to not change when a baby is left with a friendly, warm babysitter. However, if the caregiver was insensitive and cold, cortisol levels rose suggesting that the more neglectful the carer is, the more elevated the cortisol levels and the more potential damage to the brain. Perry *et al* (2007) discusses a study where infants with secure parental relationships did not have elevated cortisol levels when left with a stranger but cortisol levels rose when unpredictably the parents tried to force them to play.

High cortisol levels have been found to be associated with memory deficits. Gunnar and Nelson (1994) found a negative correlation between memory functioning and cortisol levels with some suggestion of a five per cent reduction in hippocampal volumes. A similar finding was made by Lindauer *et al* (2006) who found in clients with Post Traumatic Stress Disorder (PTSD) that higher cortisol levels were associated with memory deficits and low-

The hormone cortisol is released in the body dur-





er hippocampal volume although the exact causal relationship was unknown. Sapolsky (2003) also found a significant correlation between sustained stress, excess cortisol activity and hippocampal “memory” damage. It was suggested that hippocampal neurons respond adversely to cortisol activity and in some studies reduces volumes of up to 12 to 17 per cent. Perry (2007) cited DeBellis *et al* (1999) who studied 44 maltreated children with PTSD with a mean age of 12. Seven per cent of these children had smaller cerebral volume including the cortices and ventricles which was purported to be due to raised cortisol levels. Intellectual ability throughout the study population was lowered.

The risks of stress on the developing brain are possibly applicable even in the womb. Brennan *et al* (2008) found increased baseline infant cortisol concentrations suggesting in utero exposure by depressed mothers. It is suggested that this may alter the hypothalamic-pituitary-adrenal axis, a major mediating pathway of the stress response. It was suggested that exposure to stress during developmentally critical periods results in persisting hyperactivity of the physiological response to stress increasing the risk of stress related diseases.

Nolin and Ethier (2007) studied seventy-nine children aged six to 12 years old who were currently under the care of local social services due to one of two types of maltreatment (neglect with physical abuse and neglect without physical abuse). These children were compared with a control group of 53 children matched for age, gender, and annual family income. All were administered a neuropsychological assessment which focussed on motor performance, attention, memory and learning, visual-motor integration, language, frontal/ executive functions, and intellectual ability. Children who were neglected with physical abuse showed cognitive deficits in auditory attention and response set, visual-motor integration, problem solving, abstraction, and planning. Children who were neglected without physical abuse differed from the control group in that they obtained lower

scores in auditory attention and response set, and visual-motor integration. The authors indicated that “surprisingly”, these same children demonstrated a greater capacity for problem solving, abstraction, and planning than the physically abused neglected and control children. The results support the heterogeneity of cognitive deficits in children based on different types of maltreatment and suggest that neglect with physical abuse is more harmful than neglect alone although the latter is still significant.

In summary, neglect can lead to significant behavioural, psychological and cognitive deficits in the developing child. Of core importance is the environment which can have a significant influence on brain development. Damage can occur as a result of issues such as poor attachment, inconsistent care giving, and fearful and stressful experiences. Cognitive effects can include deficits in memory, arousal, mood, fear response and many other functions. However, this is not an exact science. Every child will have varying levels and types of vulnerability resulting in differing levels of causality. As a result one should always be mindful of the potential effects of neglect on the child’s development but aware of the individual differences which affect outcomes. ●

References

- Dubowitz, H., Pitts, S. C., & Black, M. M. (2004). Measurement of three major subtypes of child neglect. *Child Maltreatment*, 9(4), 344-356.
- Bateson, G. (1979). How do sensitive periods arise and what are they for? *Animal Behaviour*, 27, 470-486.
- Broadbent, A., & Bentley, R. (1997). *Child abuse and neglect Australia 1995-96* (Child Welfare Series No. 17). Canberra: Australian Institute of Health and Welfare.
- Brennan, P. A., Pargas, R., Walker, E. F., Green, P., Newport, D. J., & Stowe, Z. (2008). Maternal depression and infant cortisol: influences of timing, comorbidity and treatment. *Journal of Child Psychology & Psychiatry*, 49(10), 1099-1107.
- Bromfield, L. M. (2005). *Chronic child maltreatment in an Australian Statutory child pro-*

tection sample (Unpublished doctoral dissertation). Deakin University, Geelong.

Courchesne, E., Chisum, H., & Townsend, J. (1994). Neural activity-dependent brain changes in development: Implications for psychopathology. *Development and Psychopathology* 6, 697-722.

De Bellis, M. D., Keshaven, M. S., Clark, D. B., Casey, B. J., Giedd, J. B., Boring, A. M., Frustaci, K., & Ryan, N. D. (1999). Developmental traumatology. Part 2: Brain development. *Biological Psychiatry*, 45, 1271-1284.

Glaser, D. (2000) *Child Abuse and Neglect and the Brain – A Review*, *Journal of Child Psychology and Psychiatry*, vol. 41, No. 1, 97- 116.

Greenough, W., & Black, J. (1992). Induction of brain structure by experience: Substrate for cognitive development. In M. R. Gunnar & C. A. Nelson (Eds.), *Minnesota symposia on child psychology 24: Developmental behavioral neuroscience* (pp. 155-200). Hillsdale, NJ: Lawrence Erlbaum.

Gunnar, M., Brodersen, L., Nachmias, M., Buss, K., & Rigatuso, J. (1996). Stress reactivity and attachment security. *Developmental Psychobiology*, 29, 191-204.

Izard, C., Porges, S., Simons, R., Haynes, O., Hyde, C., Parisi, M., & Cohen, B. (1991). Infant cardiac activity: Developmental changes and relations with attachment. *Developmental Psychology*, 27, 432-439.

Lindauer, R.J.L., Olf, M., van Meijel, E.P.M., Carlier, I.V.E., & Gersons, B.P.R. (2006). Cortisol, Learning, Memory, and Attention in Relation to Smaller Hippocampal Volume in Police Officers with Posttraumatic Stress Disorder. *Biological Psychiatry*, 59, 171-177.

Myers, L. B., & Vetere, A. (2002). Adult romantic attachment styles and health-related measures. *Psychology, Health and Medicine*, 7, 175-180.

Neigh, G.N., Gillespie, C.F., Nemeroff, C.B. (2009) The neurobiological toll of child abuse and neglect. *Trauma Violence Abuse*. 10(4):389-410.

Nolin, P., & Ethier, L. (2007). Using neuropsychological profiles to classify neglected children with or without physical abuse. *Child Abuse & Neglect*, 31(6), 631-643.

Perry, B. (2007). *The Boy Who Was Raised As a Dog: And Other Stories From a Child Psychiatrist's Notebook* *Child Psychiatrist's Notebook. What Traumatized Children Can Teach Us About Loss, Love, and Healing*. Basic Books; New York.

Sapolsky, R. M. (2003). Stress and plasticity in the limbic system. *Neurochemical Research*, 28 (11), 1735-1742.

Shields, A., Cicchetti, D., & Ryan, R. (1994). The development of emotional and behavioral self regulation and social competence among maltreated school-age children. *Development and Psychopathology*, 6, 57-75.

Weinberg, K., & Tronick, E. Z. (1998). The impact of maternal psychiatric illness on infant development. *Journal of Clinical Psychiatry*, 59, 53-61.

World Health Organization. (2006). *Preventing child maltreatment: A guide to taking action and generating evidence*. Geneva: WHO.