Childhood Trauma and Neural Development.

Indicators for Interventions with Special Reference to

Rural and Remote Environments.

Dr. Pieter J Rossouw

School of Psychology, School of Social Work and Human Services,

The University of Queensland

Australia

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ABSTRACT: This paper focuses on the effects of childhood trauma on healthy neural development. An alarming study of 10,000 adolescents indicates that one in every four to five youths meets the criteria of a severe impairment across the lifetime. Studies also indicate the positive effects of early interventions to enhance neural activation and facilitating resilience. Historical events and current logistical obstacles in rural and remote environments indicate significant challenges to address childhood trauma resulting in enhanced risk of long term violation of basic needs. The net result is detrimental neural development, compromised resilience and trans-generational deficit. Challenges are identified and intervention strategies suggested.

Keywords: Childhood trauma; neural development; rural mental health; trauma intervention

Introduction

Current neurobiological research indicates that most mental illnesses begin earlier in life than was previously believed (Insel, Fenton 2005). An alarming epidemiological study of 10,000 adolescents in the USA indicates that one in every four to five youths meets the criteria of a mental disorder with severe impairment across the lifetime (Merikangas et. al. 2010). The study indicates the need for strategies that are based on prevention and early intervention. Studies indicate the need for enhancing neural development by decreasing exposure to unhelpful stressors that up-regulate the HPA (hypothalamus-pituitary-adrenal) axis (Schonkoff 2011). Schonkoff and colleagues (2011) indicate that interventions that enhance executive function and self-regulation and enhance the abilities of vulnerable mothers (beginning as early as pregnancy) offer promising markers to protect the developing brains of their children from detrimental neural development.
Neural development and attachment


Down-regulation of limbic alertness plays a vital role in the development of a safe, secure attachment relationship whereas unstable patterns (that is unstable emotional or physical attachment) lead to insecure, ambivalent or disorganised attachment.

These attachment patterns tend to stabilise into long term patterns of functionality or dysfunctionality depending on the initial trajectory with an alarming stability of seventy percent twenty years post initial assessment (Waters et al. 2000). This study is in line with the trend projected by the study of Merikongas 2010.

Violations of the basic human needs for attachment and control (Epstein 1993; Grawe 2007), lead to the onset of up-regulated limbic alertness, down-regulation of cortical neural sprouting, and decreased right frontal cortical development – the key risk factors for the onset of mental illness. It is a well-established fact that the right frontal cortex is in a critical growth period from the last trimester of pregnancy to ten months post birth and in a secondary growth period from ten months to thirty six months (Schore 2012). Genetic factors are expressed, through the interaction with the environment (experiences) and long term patterns of response to environmental stimuli are facilitated during this time in neural patterns. A secure attachment provides an enriched environment to facilitate significant resilience against the expression of genetic risk. Animal studies by Shen and Battersby clearly indicated the protection against expression of genetic risk through enriched environments (Shen et al 2000). Programs to enhance secure attachments and the down regulation of stress responses are highly indicated to reduce the risk and onset of mental illness.

Childhood trauma and neural growth

Childhood trauma violates the basic needs of attachment and control. Abuse (physical and/or emotional) up-regulates the survival response and inhibits frontal cortical sprouting. Early
interventions to address these needs are highly indicated. Effective programs need to be based on two key principles of neural anatomy and neural development:

The principle that the brain develops from the bottom to the top.

The first phase of neural development involves the formation of the primitive brain – the brainstem, pons and the cerebellum (the survival systems). Large numbers of precursor (stem) cells activate the production of specific neurons in targeted areas (up to 250,000 per minute).

The second phase of neural development involves the development of the paleomammalian brain - limbic structures – thalamus, amygdala, hypothalamus, hippocampus and basal ganglia (the stress and emotional response systems)

The third phase of neural development is the development of the cortical regions – the neocortex (the executive control systems).

Second: the principle of neural development and proliferation.

The principle of neural development indicates that the brain is not fully developed at birth.

The first area of the brain to fully develop is the brainstem and then the lower part of the midbrain. These areas control bodily functions necessary for life – sometimes referred to as the autonomic functions. At birth, these lower functions are fully developed and functional facilitating basic survival responses: breathing, eating, sleeping, seeing, hearing, smelling, making noise, feeling sensations and recognising people. These are crucial functions – all needed for basic survival. Violation of any of these functions will compromise survival. This is the area that MacLean (1990) named the primitive / reptilian brain – a capability shared with all living creatures. This neurological ability is crucial in the quest to understand mental well-being and disorders. Recent findings in neuroscience indicated that synaptic connections (synaptic potentials) form the basis of what constitutes “an individual” and when neural connections change, the neural networks change resulting in the individual “changing” – emotional, cognitive and behavioural changes. These changes facilitate healthy development (given safe, enriched environments) or pathology (in situations where there are violations of basic needs).

The second region that develops in the pre-natal brain is the region that involves the structures on top of the brainstem and lower midbrain – the areas in the upper midbrain
section. McLean coined the term “limbic” structures (MacLean 1990) – the thalamus (chamber), the amygdala (almond) the hypothalamus (below-chamber) and the hippocampus (sea horse). These structures evolve on each side of the brain as it begins to development towards the two hemispheres in the cortical regions.

The limbic areas are fully developed at birth but do not function optimally (in comparison to the brainstem areas that are fully operational at birth). These areas need environmental interaction to assist with the activation process. During the first ten to twelve months of the newborn’s life most of the expressions of these functions occur. Input from the environment shapes the limbic structures.

The infant brain comprises of around one hundred billion neurons. Each neuron has up to ten thousand synapses – resulting in a capacity of one trillion connections. During the first ten months post-birth synaptogenesis is facilitated at blistering pace. By year three the young brain has up to three trillion neural connections. Then the process turns around – the neural connection reduces at an even more blistering pace – millions of connections stop connecting every minute – reducing the connections back to around one trillion within a few years. And whilst this reduction is happening the brain is still developing through the process of neural pruning as the neural network becomes stronger. Effective pruning is vital for effective growth but it can only activate effectively in a down regulated limbic system - a healthy supportive and rich environment.

Violation of the safe environment – any threat to basic safety, or basic needs - also leads (among other things) to changes in the synaptic connections. However these changes result in closed neural systems of protection – facilitated by overproduction of stress hormones adreno-corticotrophin hormone, adrenalin and cortisol which push the brain into constant hyper alertness and closed neural firing – altering the networks of healthy neural patterns.

The third section of neural development brain that develops involves the upper region of the neural system - the cortex. This region is greatly undeveloped at birth – making it most susceptible for signals from its environment. A good, supportive healthy enriched environment (where the basic needs of secure attachment, control, development of sense of self, and pleasure maximization) is essential for the brain to develop connections and networks that support well-being. Violation of any of these needs causes major disruption in
the chemical production, the neural connectivity, neural plasticity, and ultimately the neural networks (Kandel et al, 2013).

The implications are significant in terms of our understanding of the development of wellbeing, and the pathogenesis of mental disorders and trauma and even more important when we consider strategies to address these issues (Van Eekelen et al, 2011).

**Bottom up development**

The development of the brain from the bottom to the top also indicates the neural pathway for the activation of distress signals. Distress signals follow a particular pattern in the excitation and inhibition of neural connections. These activities lead to changes in cortical blood flow from the upper neural (cortical) regions to the deeper neural regions to ensure effective ability to maximise the survival response. Over-activation of this survival mechanism leads to inhibition of neural sprouting to the cortical areas. Ongoing activation of this pattern has an inverse relationship with long term neural sprouting and proliferation (Rossouw, 2012). In severe cases of violation atrophy occurs in key limbic areas (especially the hippocampus), and cortical regions (anterior cingulate and sub genual areas of the pre frontal cortex) as result the ability of the individual to manage even low intensity stress is greatly reduced and cognitive and especially emotional development significantly inhibited (Van Der Kolk, Burbridge & Susiki 1997; Drevets, 2001; Schore, 2012; Rossouw, 2012b).

Without effective down regulation of limbic alertness (triggered by stress factors and violations of basic needs), neural sprouting is inhibited (Kandel 2006).

**Implications for interventions – rural and remote areas**

The implications for service delivery are significant. Effective delivery of early interventions is required to assess, identify and address violations of basic needs (especially the needs for safety and control). Effective service delivery, to enhance neural development has to be a collaborative activity between mental health services and attachment structures (parental systems).

Many rural communities have collective sense of suffering due to current and historical traumas such as Aboriginal communities affected by removal of children. These painful memories are triggered by intervening agencies attempting to assist in cases of need –
especially when assistance is not community based but linked to services that are provided outside of local areas.

Unfortunately the history of service delivery in rural and remote Australia (and more specifically our indigenous communities) shows little understanding of the implications of these neural principles. When provision of safety became a priority, without understanding the need for attachment and control, children were removed not only from the immediate area of risk but also from the whole community. These removals from community may have provided safety but could not effectively down regulate the stress/fear/control response. Further, removal from a community disempowers the community to provide care and enhances community pathology. This does not only have historical relevance as there are current cases under tribunal investigation that involve removal of young children from highly disenfranchised Aboriginal communities in far north Queensland. The preliminary findings of research at The University of Queensland coincides with the study at Edith Cowan University and shows that Aboriginal community responses have been undermined as a result of colonisation and the impact of western culture (Hovane 2012). Service delivery has mostly happened outside the communities and not in close collaboration with communities resulting in increased community disempowerment and enhancing the risk of pathology.

Service delivery to maximise neural growth needs to occur in the close proximity of the social network (community) to maximise a sense of attachment and control to facilitate healing and empowerment. Children living in rural and remote areas face significant challenges when they are in need of interventions. All research clearly indicates the need for early intervention to minimise the development of unhelpful neural patterns. But early diagnosis and/or intervention is often lacking in rural and remote areas. Localised services are often not available. This leads to interventions that may compromise the basic needs of developing children resulting in higher presentation of uncontrollable incongruence. The net result is the reduced opportunity to maximise neural sprouting, enhanced stress response activation, and long term frontal cortical deficits – resilience to HPA activation, effective emotional and personality development, high level of cognitive integration and approach behavioural patterns.

Preventative programs to enhance parental awareness of secure attachment, control maximization, neural development, nutrition, limbic regulation, and frontal cortical activation to enhance resilience need to be facilitated.
Practical strategies to maximise neural sprouting (sleep hygiene, nutrition, exercise, reduced substance abuse etc.) need to be provided in a safe, trusting environment to reduce the risk of trans-generational pathology and enhance genetic expressions towards strong safe, supportive and well communities.

References:


