



NAN Review #3
The Brain Basis of Infant Attachment

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In a recent article, Allen Schore (2002) reviewed the existing research literature concerning attachment, stress, trauma, physiology, and neuroscience. Schore investigated the connection between early attachment relationships and their effects on the infant's developing brain and nervous system within the first two years of life. This paper is a partial summary of Schore's article and focuses on secure and traumatizing attachment relationships.

It is very important for an infant to form a secure attachment relationship with its caregivers. These bonds are crucial because the infant is dependant upon caregivers for everything related to survival such as nutrients, warmth, and protection. Recent studies have shown that early attachment relationships are strongly connected to the development of critical structures in the brain responsible for emotion regulation, attachment behaviour, and stress related coping mechanisms.

The brain system responsible for instinctive attachment behaviour is located in the right orbitofrontal cortex, the outer layer of the brain behind the right eye. We will refer to this brain system and its connections as the *attachment centre*. The fact that the attachment centre is located in the right hemisphere (side) of the brain is important, because the right hemisphere undergoes rapid development during infancy. Right hemisphere development during the first two years of life is directly shaped by attachment relationships. These findings are important because we know that structures in the right hemisphere including the attachment centre hold direct influence over the infant's future ability to regulate (manage) its emotions and stress response. This is because the attachment centre holds neural connections to the cortex (responsible for higher thought), limbic system (emotional centre), and the autonomic nervous system (stress response).

A brief review of the autonomic nervous system clarifies why it is linked to the attachment relationship. Essentially, the autonomic nervous system is composed of two separate branches, the sympathetic branch, and the parasympathetic branch. The sympathetic branch is energy expending and is responsible for the 'fight or flight' response in which the body diverts resources from systems such as digestion and elimination and re-directs energy to respond to an immediate threat. When we are threatened, our bodies kick into 'high gear' in which heart rate and breathing increase significantly, pupils dilate to enhance vision, and increased levels of sugar are directed to

the muscles. In addition, certain brain chemicals such as adrenaline and stress hormones are released. This response prepares the body to fight the perceived threat, or run away from it. It is important to note the sympathetic branch reacts to emotional stress as though the emotional stressor is a threat to physical survival. As soon as the situation is thought to be safe, the *parasympathetic* branch takes over. It is energy conserving, and returns the body to a relaxed state. The parasympathetic branch slows heart rate and breathing to a normal level, and redirects the body's energy to digestion and immune functions.

Of great significance, the attachment centre is centrally involved in controlling autonomic nervous system reactions to emotional events. The caregiver's behaviour directly influences the infant's autonomic nervous system. When a caregiver's behaviour is calming, the infant is likely to develop a secure attachment. When a caregiver's behaviour is frightening or distressing, the infant is likely to develop an insecure attachment and may even become traumatized. In the sections that follow, we examine the brain basis of two extreme types of attachment relationships - secure and traumatizing.

Brain Basis of Secure Attachment

In order to foster a secure emotional bond, the caregiver engages in finely tuned interactions with the infant. The caregiver monitors the infant's emotional state and gears her/his responses to keep the infant at an optimal level of mental and emotional stimulation. In this way the caregiver is keeping the infant in a state of balance and inadvertently regulating the infant's emotional state and autonomic nervous system. In fact, the secure attachment relationship is mirrored within the autonomic nervous system of both the caregiver and infant. For example, during play, both caregiver and infant show sympathetic heart rate increases followed by parasympathetic heart rate decreases in response to the smile of the other. Consequently, the caregiver's and infant's signals to each other are experienced in their autonomic nervous systems as they both excite and calm each other during their interaction, thus creating a harmonious interaction between caregiver and infant.

When the infant displays distress, the caregiver quickly and adequately acts to provide comfort in order to reassure and calm the infant. In this way, the caregiver manages the infant's stress level by providing comfort when the infant is distressed. Through repeated interactions with a comforting caregiver, the infant's nervous system learns that things will be 'set right again' by the caregiver. This learning shapes the development of the infant's nervous system and the infant will eventually be able to self-soothe and regulate (manage) its own emotional state. In this way, the caregiver is initially calming and soothing the infant while the infant's brain and nervous system develops the capacity to calm itself.

Brain Basis of Infant Trauma

In contrast to the comforting and calming care-giving described above, abusive care-giving causes extreme levels of distress in the infant through abuse or neglect. An abusive caregiver is either unavailable to respond to the infant's distressed emotional state or responds with anger, ridicule, or rejection. As a result, the caregiver is not only causing extreme distress in the infant but is also failing to provide comfort during times

of need. Unfortunately, the infant's intense negative emotional state extends beyond just a negative *feeling*. The intense negative emotion activates the stress response of the sympathetic nervous system. Because the infant's autonomic nervous system is immature it is unable to control this heightened stress response and remains in this state for extended periods of time. Indeed, the infant is at the 'mercy' of this stress state because while it is fighting to manage the stress response, it is unable to do anything else. This situation is harmful to the infant's development as they miss out on other emotional and social learning opportunities.

An infant who is repeatedly traumatized will resort to two separate response patterns, hyperarousal and dissociation. These response patterns accompany certain biochemical changes in the developing brain. The hyperarousal state occurs with the sympathetic nervous system springing into action and maintaining a stress response for extended periods of time. As a result, the infant's brain is continually exposed to high levels of the brain's major stress hormones which become toxic when maintained for extended periods of time. This state is characterized by the infant's crying, screaming and displaying extreme emotional distress.

The second and later reaction to infant trauma is dissociation, in which the infant passively disengages from the environment as a last and desperate attempt to manage its stress response. Behaviours typical of the state of dissociation include withdrawal, avoidance, and extreme passivity with minimal displays of emotion. In the dissociated state, the parasympathetic branch of the autonomic nervous system is dominant and provides a last resort strategy to deal with extreme continuous and helpless distress. The state of dissociation is expressed in decreased blood pressure, metabolism, and heart rate. This calming physical response occurs despite elevated levels of stress hormones such as adrenaline and cortisol circulating throughout the brain and body. In this way the infant passively disengages from the environment in order to conserve energies.

Conclusions

The outcome of secure attachment results in a child (and later adult) who is able to effectively manage emotions and cope with stress. This is because the securely attached infant's caregiver initially regulates the infant's stress response while its nervous system develops the ability to cope on its own. However, the result of continued trauma during the first two years of life is extremely harmful to the infant's developing brain and nervous system. Because the brain is rapidly developing during the first two years of life, it is extremely vulnerable to continued exposure to toxic stress chemicals. Studies have found that attachment-related trauma leads to the delay or arrest of development in the right hemisphere of the brain. This disruption in development may result in the infant's future inability to manage emotions and cope with stress. Unfortunately, attachment-related trauma leaves the traumatized infant vulnerable to stress-related psychiatric disorders such as depression and anxiety in his/her later adult years.

On a more positive note, clinicians have developed attachment interventions such as Watch, Wait, and Wonder (Cohen et al., 2003) and Modified Interaction Guidance (Benoit et al., 2001). The primary goal of these interventions is to adjust the emotional communication abilities of caregivers while interacting with their infants. Optimally, these interventions would occur as early as possible in the infant's life to influence the outcome of the infant's future emotion management and stress coping abilities.

References

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