Building the Brain with “Procedural” Knowledge: Clinical implications of neuroscientific studies.

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MANY KINDS OF MEMORY

Fifteen years ago, neuroscientific research articles began to confirm that humans have many kinds of memory, not just one. This validated the experience of many parents, teachers and therapists around the world. We had experienced and witnessed motor skill learning, musical skill development, and the fact that high emotion could, in separate instances, either enhance memories or block them. But these ways of “knowing how to do something” had always been difficult to describe. Most frequently, any type of memory that did not include words was simply called “non-verbal”. In fact, very often, non-verbal skills, habits and behaviours seem to defy description. Thus, the commonly understood examples of swimming, riding a bike, or playing a musical instrument are often used as examples of what we now call “non-declarative” or “procedural” knowledge. But “procedural” knowledge (also called “procedural memory”) covers a much wider range of human behaviour and learning than these examples might imply.

Today, we are lucky to have a number of excellent works that describe in much greater detail many types of learning /memory that are examples of non-declarative (also called implicit / non-conscious/ or procedural ) knowledge, as well as clarifying the neural processes involved in creating declarative (or explicit / verbal / conscious) knowledge (Siegel, 2001, 2003; Grigsby & Stevens, 2000; Cozolino, 2002). Each of these carefully researched books highlights a number of crucial aspects of our newly acquired knowledge of human brain development.

THE DEVELOPING INFANT BRAIN

The infant brain is formed gradually over the first few years of life. From birth, the right hemisphere is fully functional immediately, while the left develops gradually over the early months and years of the infant’s life (Schore,1994; Cozolino, 2002). Each infant's unique experience of interaction with the
environment has an impact on his or her developing brain, as the brain is a ‘use-dependent organ’ (Perry, 1995, 1997; Siegel, 2003; Schore, 1994), establishing neuronal pathways based on activity triggered by experience. (Sander, 1975, 2002; Siegel, 2001). Within genetic parameters, the human brain develops in response to being “used” in interactions with the particular environment within which an infant develops. The result of this amazing aspect of evolutionary adaptation is that *every human brain is unique.*

Procedural memory in particular, is a crucial part of the attachment process, and is the neurophysiological basis for much of our human learning. As such, it is not only important to understand procedural memory as a contributor to educational experiences, but as the first line of defence for an infant, in learning how to survive in the interpersonal environment into which he or she was born. The newer, more detailed descriptions of procedural memory, in particular, illustrate how this aspect of human memory is essential to our survival. In his book *Parenting from the Inside Out,* Daniel Siegel (1999) captures the nature of the infant brain:

> The brain can be called an “anticipation machine,” constantly scanning the environment and trying to determine what will come next. Mental models of the world are what allow our minds to carry out this vital function that has enabled us as a species to survive. Prior experiences shape our anticipatory models, and thus the term “prospective memory” has been used to describe how the mind attempts to “remember the future” based on what has occurred in the past. … Anticipating the future may be a fundamental component of implicit [procedural] memory, distinct from the capacity to plan for the future. The more complex and deliberate aspect of planning may depend upon the explicit memory processes such as declarative memory. (Siegel, 1999, pg 30-31)

While he did not use the terms “non-declarative” or “procedural” in his writing, the essence of “procedural memory” was studied and described, more than thirty years ago, by Louis Sander - although those in the professional world of child psychiatry and infant mental health were, for the most part, unable, at the time, to grasp the importance of the dynamic biological system linking mother and infant, that Sander so carefully articulated (Sander, 1975; 2002). To be fair, in the late 1960’s and early 1970’s, when Sander’s earliest studies were published, we did not have the capacity to study brain scans of infants as they developed. In 1987, John Bowlby commented that, “until we can see what is happening in an infant’s brain, all our ideas about what goes on there are simply speculation.” (personal communication). Now, twenty years later, thanks to technological advances,
we can, in a manner of speaking, actually “see” inside an infant’s brain. What is important here is that a great many of the careful naturalistic observations of infants and mothers made during those early years by Sander, Bowlby and Ainsworth, and others, have now been substantiated by the findings of neuroscience research in the last decade (Schore, 1994; Grigsby & Stevens, 2000; Cozolino, 2002; Sonnby-Borgstrom, 2002, 2004).

A commonly held belief, that human memory was a unitary “storage area” located in the brain, has been replaced by the knowledge that humans have multiple neural networks that constitute many kinds of encoded knowledge (Gruzelier, 1988; Perry, 1995; Moore, 1998; Sander, 2002; Grigsby & Stevens, 2000). What has not been clear until recently is the fact that implicit, procedural memory is precisely the category of knowledge that Bowlby talked about as an “internal working model” (Bowlby, 1969; 1988). The neuroplasticity that creates pathways in the brain based on lived experience, is the capacity, available from birth, that allows the infant to “anticipate interaction with the environment,” to construct a neuronal pattern of expectancy. (Sander, 1975, 2002; Beebe & Stern, 1977; Murray, 1980). From birth, the infant brain constructs neurological pathways as a result of particular experiences. This allows the brain to begin to predict what experience might happen again: to anticipate the familiar. That which is familiar is construed as “safe” when the survival-related emotions of fear or terror were not elicited by the behavioural interchange. Novel experiences of undetermined emotional/physical impact will be experienced by the infant as “strange” and potentially dangerous (Bowlby, 1969; Trevarthan, 1977; Murray, 1980).

In one of the most clearly written, informative and yet, ironically, least-often considered analyses of Bowlby’s work, Victoria Hamilton addresses the evolutionary purposes at the heart of Attachment Theory:

Throughout his work, [Bowlby] stresses the over-riding importance of the parameter ‘familiar/strange’ in the development of human beings from cradle to the grave. From infancy on, we tend to orient towards the familiar and away from the strange, a trait that has survival value for human beings and other species. We change our beliefs with reluctance and would rather stick with the familiar model. (Hamilton. In: Reppen, 1985, p.2)

In terms of evolution, what is known and familiar can be predicted and is linked to feelings of “safety”. What is novel and cannot be predicted is viewed as potentially dangerous. Conditions that typically trigger an increased adrenal response (“fight or flight” responses) and also, intensify attachment needs in humans, as a result of rendering the environment unpredictable, include being in
the dark (because our defences are so dependent upon being able to see), being isolated or alone, being physically ill, and being confronted with an unpredictably threatening interpersonal environment. Hamilton reminds us that each of these conditions is based on a real survival need of the human infant, adding that, ‘Ironically, psychoanalysts do not recognise that this “cognitive bias” (Bowlby, 1980) is functional and tend to regard the preference for the familiar as regressive.’ (Hamilton, in: Reppen, 1985, p.2)

PROCEDURAL PROCESS BUILDS THE BRAIN THROUGH EXPERIENCE

In a recent publication, Graham Music reminds us that as the human brain develops - especially the infant brain - experience is filtered through pathways ready-formed by previous experiences, ‘just as water will flow down already formed channels.’ He identifies the phrase ‘cells that fire together wire together’ as a description of what is called Hebb’s Law, after the ideas of the neuroscientist Hebb, whose book *The Organization of Behaviour* was published in 1949.

Hebb’s Law describes the process whereby particular neuronal pathways form at the expense of other potential pathways, and become standard ways by which one expects one experience to follow another experience if they have previously gone together. (Music, 2006, p.44).

Investigating aspects of infant development and infant/parent mental health issues, Louis Sander anticipated the very findings that underly our current understanding of “procedural memory.” Sander was interested in exactly the neurodynamic process described above when he conducted his studies of neonates and their mothers in the 1960’s – 1970’s. He documented the exquisitely responsive biological behaviours that mother and infant jointly produce, as they interact with each other to form a “dynamic system” of neurobiological processes (Sander, 1964; 1969). An analytic psychiatrist working in Boston, Sander measured the mother/infant intersubjective process that Winnicott was describing in London (Winnicott, 1963).

In a paper given in Denver, Colorado, in 1975, Sander discussed the results of a particularly innovative and poignant study that he called ‘The Masking Experiment’ (Cassell & Sander, 1975). Sadly, the work was not published until recently. Fortunately, Sander included a summary of that revolutionary study in a recent invited review of his 55 years of work in the emerging fields of infant psychiatry and infant mental health (Sander, 2002). The study involved thirty, 7-day-old neonates and their mothers, during a time when a mother and her infant were offered a week of post-natal care in
hospital. The hospital providing the mother-infant dyads for this experiment was St. Mary’s, in London.

It is important to remind the reader in 2007 that, at the time this experiment was carried out, doctors commonly believed that a week-old infant could not focus well enough to see its mother properly, could not recognise or differentiate her from other adult women, and could have no established ‘memory’ of experience with its mother. As this particular study is not well known, I will quote at some length from Sander’s description of one infant who participated in the experiment with its mother. The reactions he describes were common to the entire group of infants:

We had been recording infant states and caregiver interaction around the clock from the delivery room onward with “bassinet monitors” using healthy, natural mothers rooming-in and bottle-feeding their healthy new babies.

On the morning of the seventh day, as the infant first showed signs of transition to the awake state, we asked the mother to put on a mask—an ordinary knitted ski mask—but otherwise to carry out her caregiving in every way exactly as she customarily had been doing. At the appropriate moment she picked up the infant and began her usual sequence of changing the baby’s diapers [nappies] and gown, holding the baby while getting the bottle for feeding, and, finally, sitting down in the feeding chair. During the preparatory procedures the infant had looked in the direction of the mother’s face repeatedly without the slightest evidence of a change of state. The mother found her comfortable position in the chair, with her infant on her left arm. Only at the moment she brought the nipple of the bottle to the infant’s lips, did the looking directly at the mother’s face transform the infant in a dramatic surprise reaction.

Although its lips were now open, there was not the slightest interest in the nipple that the mother was moving gently in and out to try to get the baby to start sucking. The baby continued staring at the mask and looked at it from different angles as it moved its head from side to side. It was almost a minute and a half before the infant finally took the nipple and began sucking. But the feeding was not as customary, with the infant gradually becoming drowsier and terminating the feeding by falling asleep, as in the days previously. Its state now was one of arousal throughout, with feeding interruptions, spitting up, choking, followed by a long transition from this state of arousal to sleep, requiring almost an hour after the mother had returned the infant to the bassinet. (Sander, 2002; pp 29-30)
Sander concludes that, by the seventh day, the infant had assimilated the gestalt, or background of a sequence of interactions with the mother around feeding, and that interactive sequence including all the associated sensory components had become familiar to the infant. It could be called a complex ‘gestalt of organization in the [mother-infant] system’ in the sense that Konrad Lorenz describes it: ‘Gestalt perception is able to take into account a greater number of individual details and more relationships between these than in any rational calculation.’ (Lorenz, 1971. p.154, as quoted in Sander, 1975; 2002)

[This was] a recurring flow of context that could set the stage for the profound reaction to the violation of the infant’s expectancy of the familiar configuration of the mother’s face. But it was only at a specific point in the sequence - the moment when the infant initiates its [own] act of accepting the nipple for the onset of sucking - that violation of expectancy of the mother’s face is experienced so profoundly. (Sander, 2002, p. 30, emphasis mine)

Sander’s detailed observation illustrates the neonate’s sensitive dependence on the stability of a familiar, recurring, interactive pattern as a kind of ‘precursor’ to later infant “social referencing” behaviour; the complex gestalt of facial recognition and contingent exchange of affective expression with the mother, were a necessary framework within which the infant could safely and meaningfully initiate self-organizing, need-gratifying interactive behaviour.

FURTHER EVIDENCE LINKING MATERNAL CONTINGENCY AND INFANT’S CAPACITY FOR AGENCY

What Sander describes in the ‘The Masking Experiment’ is evidence of the laying down in the neonatal brain of neuronal pathways linked to repeated experience with the environment, described by Music and others above (2006). This contingent interpersonal dynamic between mother and infant, described by Sander in 1975, is what Lynne Murray’s studies brilliantly illustrated in 1980, namely, that when an infant participates in a familiar ‘procedural’ interactive sequence, and an anticipated moment of agency arrives for the infant, where self-organized behaviour should be initiated as part of a sequence of micro-behaviours, an inability to find the familiar mother’s contingently responding face blocks the act of self expression. The lack of a contingently responding “other” derails the infant’s participation, in interaction with the mother as an “agent” of his or her developing, independent self.
I am referring to Murray’s finding that 6-8 week old infants, when confronted with their mother interacting with them live, via an AV system and a TV monitor, will actively engage with her-- after some understandable initial confusion, or mild distress resulting from the novel environmental situation. Importantly, they respond with positive affect when they “find” her face on the screen and hear her voice. However, when confronted with a pre-recorded video tape of the mother’s face, made while she was previously interacting happily with that same infant, the infants did not initiate behaviours to try to engage the mother. The babies typically looked away, or down, sometimes glancing back at the screen briefly out of the corner of their eye. They fingered their clothing, and touched their face more than usual, but none of the infants expressed negative affect directly toward the mother’s face, on the TV monitor.

On the very few occasions when an infant attempted to engage the mother by beginning to smile at her, there had occurred a coincidental smile on the mother’s video-taped face, just when the infant glanced back at the screen. In these few cases, the infant’s smile faded rapidly as it became clear that there was no contingency in the mother’s behaviour. Importantly, these infants, unlike infants facing a live mother holding a “still face,” were to all intents and purposes blocked from engaging with the mother in the familiar behavioural sequence. They were unable to express distress or anger toward her image on the screen. Infants deprived of a live, contingent interaction with the mother, cannot initiate self-organizing behaviour to connect with her, or “repair” a disrupted attachment relationship (Tronick, 1997).

Because I knew that many times, infants participating in “still face” experiments with their mothers, did express distress and negative emotion directly toward the mother, before they “gave up” and became listless when she did not respond to them as she usually did, I was especially struck by the fact that in neither situation did infants facing a video-taped image of their mother express overt anger or distress towards her. Any expression of negative affect or distress was directed entirely away from the video-taped mother’s face in Murray’s study, when the infant was looking at the screen. My understanding of this behaviour was that the ‘familiar (contingently responding) mother’ was not present within the physical shape of ‘mother’ on the screen. Without an anticipated, contingently responsive, familiar and safe interaction pattern being shared with the mother, the infant experienced him or herself as suddenly in an unfamiliar and potentially dangerous situation. This perception in the infant would heighten the need to exhibit attachment seeking behaviours, but until the mother was ‘present’ again, it would be unsafe to do so, as there would be no safe, predictable ‘other’ with whom to interact. Faced with this dilemma, the infant can neither fight nor flee, and a “freeze” response,
blocking any behaviours that would be initiated by the infant, is triggered as an innate survival response (Moore, 1985).

BRAIN STRUCTURE IN INFANCY AND INTERNAL WORKING MODEL OF ATTACHMENT

As we now know, implicit, procedural knowledge of interpersonal interaction influences the earliest experiential structuring of the infant brain. This early structuring is an incipient development of a specific ‘internal working model’ of attachment (Bowlby, 1969) and occurs in the early days and weeks after birth (Schore, 1994; Glaser, 2003; Perry, 1995). Furthermore, the work of Tronick and colleagues has taught us the importance of ‘affective repair’ after a disruption in the mother-infant shared process (Tronick & Weinberg, 1997).

Of course, Sander’s 7-day-old neonates had little experience in the interpersonal attachment world as yet, but they seem to have responded to the violation of expectancy when anticipating seeing the mother’s face, not by expressing anger towards the ‘unfamiliar’ mother, but by redirecting their distress and confusion regarding the ‘shock, and loss of the familiar mother’ into somatic responses such as intense, long-lasting arousal, gastric distress, and involuntary dysregulation of normal, practised eating behaviours such as sucking, swallowing, and breathing during feeding.

In the Sander and Murray experiments, the mother returned to her normal self after the masked or “non-contingent” sequences, and their infants immediately returned to a normal pattern of expectancy and safety in behaviour toward the mother. However, were a child to experience again and again unpredictable, non-contingent behaviours from the mother, the learned interpersonal ‘procedure’ would be that direct expression of distress towards the mother is not possible. In such a case, the infant/child’s body will naturally be utilised to hold the somatic symptoms of blocked negative emotions, arousal and anger. Thus, we can see the beginnings of chronic stress, physical anxiety and arousal becoming a connected, self-organizing ‘procedural’ pattern of interaction.

There are many ways we might think about the implications of these provocative studies, and the neurobiological dynamics underlying overt behaviours where the expression of distress toward an attachment figure, or the initiation of goal directed behaviour to meet one’s needs, is blocked as part of a pattern of “procedural knowledge” about oneself. But before turning to that aspect of our understanding, I would like to address two additional ways that “procedural knowledge/memory” helps to explain some confusion about the ways that one’s history influences one’s present and future development.
UNDERSTANDING THE LINK BETWEEN THE ADULT ATTACHMENT INTERVIEW AND A PARENT’S ATTACHMENT TO A PARTICULAR CHILD

I have spent some time discussing recent neurobiological studies that confirm some of the initial observations of insightful child development and attachment experts as early as 35 years ago. We can now recognise that knowledge and memory can be encoded and triggered in the brain in a multitude of ways, and that each person’s system of neuronal pathways will have been influenced in part by the specific experiences they have had within their environment. This understanding helps explain some discrepancies in what are at times overly simplified interpretations of psychological and attachment theory or research.

With continually more nuanced neuroscientific research available, we can understand the reason why a pregnant mother’s AAI score (George, Kaplan & Main, 1990) is likely to predict her resulting attachment to her first child (Steele, Steele & Fonagy, 1997; Fonagy, Steele & Steele, 1991a). We can also understand why it is that her score during pregnancy with any subsequent children is much less likely to predict the attachment style she develops with those additional children. Because of the neuroplasticity in all human brains, interaction with her first child actively alters the maternal brain. She is in fact, a ‘different mother,’ with different neurological pathways activated in her procedural memory, for each of her children. (Cozolino, 2002, pp. 82-83)

New evidence for exactly why this is the case has emerged from the field of cognitive neuroscience, and it relates largely to the impact of ‘procedural’ memory as it changes the structure of the parents’ brains. The neuroplasticity of important areas in the adult brain results in structural change due to interpersonal experience, and several recent studies give evidence that typically, the parents’ neural pathways for knowing and remembering interpersonal experience are altered through the interactions with a child. Anyone alive in what we might loosely call ‘the real world’ is aware that there is normally a period of ‘heightened maternal arousal and responsiveness to the newborn, after childbirth.’ (Fleming & Corter, 1988) To substantiate the neurobiological causes of this condition, neuroscientists have studied and confirmed the neurobiological alterations in brain processing that are part of these closely observed and documented maternal responses.

In very recent studies, long-term alterations in brain structure and responses are documented in adults who are parents. Our socially attuned human brain is evolutionarily designed to respond when we hear the sound of crying or laughter. The amygdala is triggered regardless of previous ‘attentional’ state (Sander & Scheich, 2001). Simply by measuring the intensity of amygdala response in a group of
adults (men and women), as each individual heard an infant crying or laughing, neuroscience researchers were able to differentiate parents and non-parents. The study effectively measured structural neuro-anatomical changes in the adult brain due to prior experience as a parent (Seifritz, et al, 2003).

NEUROLOGICAL STUDIES HELP DIFFERENTIATE ‘CONSTRUCTED’ VERSUS ‘INDELIBLE’ MEMORIES OF ABUSE

Turning to a very different topic, one of the issues that erupted into an acrimonious debate in the 1990’s was the idea of a ‘False Memory Syndrome’. It became the focus of many publications and counter-publications in the clinical field (Moore, 1998; Sinason, 1998; Fonagy, et al, 1998). Very sensitive new neuroscience studies of human memory capacity – especially procedural or implicit memory -- have clarified how that debate raged on for a decade, without resolution, both sides producing psychological test results that supported their beliefs. By applying the new research to the debates over memories of abuse, and over the possibility of creating ‘false memories’, we can understand why there are such divergent claims regarding the capacity to ‘forget’ or ‘remember’ abuse experiences, or to ‘install false memories.’ (Sinason, 1998; Paley & Alpert, 2003; Gaensbauer, 1995b)

In order to consider the questions above, we need first to identify the links between brain activation patterns in ‘dissociative’ mental states (often associated with abuse experience) and hypnotic trance states. Researchers have continued to confirm the unique overlap between the two mental states, in terms of the specific patterns of neurological activation in the brain (Conway, 1998; Gruzelier, 2006). Initially, in the late 1980’s, Gruzelier and colleagues found there were measurable differences between the brain states of hypnotised individuals and those ‘feigning’ being hypnotised (Gruzelier et al, 1988). He found that the authentically hypnotised brain shares with the dissociated brain the pattern of a deactivated frontal lobe, reducing the individual’s capacity for largely left hemisphere reality testing. Thus, verbalisations by another can be ‘accepted’ as true, despite the fact that at a more implicit level, the individual is aware that they are behaviourally false. By activating this neurological pattern, dissociation and hypnosis both cause the ‘thinking brain’ to disconnect from behaviour and words of self and others.

In his chapter “Transformations of Abuse”, Conway (1998) details the crucial clinical implications of this documented neurophysiological shift in active brain areas, examining the possibility that one might inadvertently ‘create’ a false impression of experience when interacting with a dissociated individual who may be at that moment highly ‘hypnotisable’ (Conway, 1998; see also Moore, 2000).
Information that is presented to an individual who has a fully activated right hemisphere and midbrain, will trigger neurological activation in the amygdala, the part of the brain associated with encoding information related to survival. With a left hemisphere frontal lobe that is “deactivated” by the dissociated state/hypnotic trance, there will be little or no “reality testing” as to the validity of what is being learned.

At this point in time, neuroscience researchers have clarified that different types of memories/knowledge about the same experience, are held with different degrees of indelibility linked to the processing of separate parts of the brain (Cozolino, 2002; Siegel, 2003). Schiffer et al. (1996) have shown that abuse may affect cortical development by activating monoamine transmitters that exert trophic effects. They do this by enhancing stress hormones that can affect cell migration, glial mitosis, and myelination, and by affecting the flow of information between the right and left hemispheres. Brain processing of experience is not only specific to the individual, but there is clear evidence that stored memories linked to the hippocampus can be recalled, and, to some extent, reconstructed through that remembering and through verbalising. By contrast, emotionally traumatic memories of pain or abuse that are stored with links to the amygdala are “almost indelible and impossible to alter”, owing to their being encoded as life-threatening in some way. (Zola-Morgan et al, 1991; Perry & Pollard, 1998; LeDoux et al, 1989).

In this way, portions of memories will indeed be malleable, when linked to the hippocampus, but other aspects of the same experience may be encoded as procedural, non-declarative, unconscious knowledge: neuronal pathways linked to the amygdala, as accurate and indelible memories of experience. Those supporting each side of the “False Memory Debate,” can find neurological evidence to prove their own position as correct, and neither can prove the other wrong, because the question being asked was the wrong question. This is yet another both/and situation in human neurological development, rather than the “either/or” we seem to seek more often, in our desire to be able to label and predict our environment.

**IMPLICATIONS OF NEUROSCIENTIFIC STUDIES FOR UNDERSTANDING AN INDIVIDUAL’S SHIFTING CAPACITY FOR SELF-REFLECTION**

One final issue directly related to procedural memory with its crucial basis in an individual’s unique history, is the concept of “self-reflective capacity.” The idea of an individual as being capable of “self-reflective function” (Fonagy & Target, 1997; Fonagy et al 1991b) is often stated as though it were a generalised skill; one either has the ability to reflect on oneself and on others’ differing states.
of mind, or one has not. However, because of the variety of ways the mind can hold information—due to the process of encoding interpersonal experience in large part as non-conscious (non-verbal), procedural memory—the specific developmental, interpersonal history of an adult, especially those experiences that occurred during the first three years of life, is usually unavailable to verbal recall. Coded as implicit procedural knowledge, these early experiences will allow the development of a capacity for “self-reflective awareness of others’ differing mental states” in certain contexts and with regard to certain topics, but not in others.

A parent who is able to understand an infant’s desire to separate, explore and find excitement in other things in the world besides mother, may not be able to imagine her infant having hunger that is not linked to greed, or distress that is not an attempt to attack or persecute the mother. These alterations in the ability to use reflective function will be a result of this parent’s own experiences, and brain scan data will reflect frontal lobe capacities enhanced in non-emotionally triggering situations, but reduced in contexts triggering “unresolved” traumatic memories. (Siegel, 2003, pp. 125-134). In a recent study of adult brain responses to “ambiguous,” potentially concerning, interpersonal scenarios, carefully compiled fMRI (functional Magnetic Resonance Imaging) data show a sharp decline in left hemisphere and frontal lobe activity - where we hold the capacity for thinking, planning and verbalising about “self and other” (i.e. the capacity for self reflection). Additionally, when the context of the interpersonal stimulus includes personally traumatic or emotionally triggering elements for the viewer (such as a sketch of a person in a cemetery), there is an increase in right hemisphere limbic and amygdala activity - where the experience of thought or self-reflection is not possible, but procedural memories of threatening experiences may be triggered. (Buchheim & George (in press); Buchheim, et al, 2007).

SOME ADDITIONAL PAPERS EXPLORING CLINICAL APPLICATION OF THE ONGOING NEURO-SCIENCE RESEARCH

One of our main goals as therapists and teachers is to find ways to apply these new theoretical and neuro-physiological research findings. Fortunately, a number of excellent papers have been published on exactly this topic (Glaser, 2003; Music, 2006; Rustin & Sakael, 2004; Beebe, 2006; Seigel, 2003) Some papers focus almost entirely on the issue of procedural memory and “enactments” in psychotherapy with adults (Ginot, 2007; Grigsby & Hartlaub, 1994) and children (Gaensbauer, 1994, 1995a; 1995b; Moore, 2000, 2007).
CONCLUSION

Probably foremost in our thinking should be an acute awareness of the physical and interpersonal environment in which we work with children, whether they have a documented trauma history or not. Knowing that early experiences will have established pathways of expectancy in terms of self-other behaviour for all individuals, it is important for us to spend our initial time with our students, or our patients, observing them and wondering how they might be experiencing our shared environment.

This type of thinking about another, with the awareness that one can guess from experience, although it is not possible to know objectively, what another is feeling at a given moment, establishes the other as a separate entity, a unique agent. The nonverbal behaviours that result from merely holding this concept in mind – that one does not know what another is thinking or feeling; that mind-reading is not possible – establishes an interpersonal boundary while simultaneously connecting with the other person at an emotional level. Schore refers to this type of communication as “right brain to right brain” communication (Schore, 1994; 2000). Murray refers to this interpersonal verbal style as “child centered” or “other centered.” (1980; 1985)

In each case, our behaviour will be experienced procedurally by our student or patient, whether it is registered consciously or not, as a responsive engagement that is contingent to his or her expression of self. And no matter what else occurs for the child, this manner of interacting will trigger brain activation that enhances his or her experience of agency and selfhood.

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