Children Australia
Volume 40 ▌ Number 2 ▌ pp. 104–113 ▌ © The Author(s) 2015 ▌ doi:10.1017/cha.2015.13

Plenary Address, Australian Childhood Foundation Conference Childhood Trauma: Understanding the Basis of Change and Recovery

Early Right Brain Regulation and the Relational Origins of Emotional Wellbeing

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During the past two decades an explosion of interdisciplinary research, especially in developmental neuroscience, has transformed and deepened our understanding of how the seminal social emotional events of infancy indelibly impact, for better or worse, all later stages of human development. In this article I briefly summarise my contributions in regulation theory towards that effort. After describing a current paradigm shift in the developmental sciences, I present an overview of my ongoing studies on the interpersonal neurobiology of the mother–infant attachment relationship. I offer research which indicates that optimal attachment experiences facilitate the experience-dependent maturation of the early developing 'emotional' right brain and thereby a predisposition for emotional wellbeing in later stages of life. I conclude with thoughts about the application of regulation theory for early intervention and prevention programs, as well as some larger implications for family law, cultural and political systems, and human capital formation.

■ **Keywords:** regulation theory, interpersonal neurobiology, right brain, attachment, emotional wellbeing

Introduction

In a recent editorial in the *Journal of Child Psychology and Psychiatry* entitled 'Developmental neuroscience comes of age', Leckman and March (2011) describe 'the phenomenal progress of the past three decades'. Looking both into the past and into the future they boldly assert:

> It has . . . become abundantly clear that . . . the in utero and immediate postnatal environments and the dyadic relations between child and caregivers within the first years of life can have direct and enduring effects on the child's brain development and behavior . . . The enduring impact of early maternal care and the role of epigenetic modifications of the genome during critical periods in early brain development in health and disease is likely to be *one of the most important discoveries in all of science that have major implications for our field.* (p. 334, my italics)

Indeed, over these decades a large body of interdisciplinary research has demonstrated that early brain development is not just genetically encoded; rather, it needs epigenetic social experiences. Scientists are now describing gene–environment interactions, and offering models in which Mother Nature *and* Mother Nurture combine to shape Human Nature. These epigenetic factors in the social environment that impact genomic mechanisms are expressed within the mother–infant attachment relationship. Researchers, as well as clinicians, are eagerly looking for clinical applications of current knowledge about the critical biological and psychological aspects of early attachment experiences, both in optimal and non-optimal relational contexts.

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Toward that end, over the same three decades my contributions to the burgeoning field of developmental neuroscience have focused on the neurodynamics and psychodynamics of attachment, an essential evolutionary mechanism of early human development. My work in interpersonal neurobiology attempts to elucidate precisely how optimal *emotional* attachment experiences shape and sculpt the early developing '*emotional*' right brain, and thereby the origins of an enduring background sense of subjective *emotional* wellbeing. My studies in developmental affective neuroscience focus not only on the processing of social–emotional information but also on the regulation of bodily-based affective states, a central mechanism of the attachment dynamic. In parallel, my contributions in developmental neuropsychoanalysis and psychodynamic psychotherapy continue to explore the problem, how do relational experiences, especially in intimate contexts, fundamentally influence the growth of the subjective, unconscious mind? Neuroscience thus lies at the core of what I have termed regulation theory, an interpersonal neurobiological model of the development, psychopathogenesis and treatment of the early forming emotional core of the subjective self.

The progression of regulation theory over these decades reflects the ongoing incorporation of the rapidly expanding body of research on the earliest stages of development into my writings. At the outset, in 1994, I began my first book with the assertion, 'The understanding of early development is one of the fundamental objectives of science. The beginnings of living systems set the stage for every aspect of an organism's internal and external functioning throughout the life span' (Schore, 1994, p. 3). My work over the ensuing 'decade of the brain' continued to report an increasing number of studies in this area, and by 2009 I was able to offer an invited plenary address to the American Psychological Association on 'The paradigm shift: The right brain and the relational unconscious' (Schore, 2009a). In my recent book I continued to track the paradigm shift from behaviour, to cognition, to bodily-based emotion, and from the language functions of the left brain to the emotional functions of the right brain, in both the research and clinical disciplines (Schore, 2012a). This transformation of our conceptualisation of human development is being fuelled by three converging forces, and it has deepened our understanding of the origins of an essential adaptive capacity of human beings – that is, a subjective sense of emotional wellbeing.

Paradigm Shift in Early Development: Left Brain Cognition to Right Brain Emotion

The first theme of the ongoing paradigm shift is expressed by the increasing trend within psychology, psychiatry and neuroscience to simultaneously emphasise the *centrality of emotion* (even more than cognition) in the human experience. Building upon the neuroscience of the past century, I described in 1994 the neurobiological 'primacy of affect' – that right brain affective processes operating at levels beneath conscious awareness are dominant in development, psychopathogenesis and psychotherapy. In 2003, citing research over the ensuing 10 years, I wrote that affective processes lie at the core of the self, and were moving towards brain–mind–body conceptualisations due to the intrinsic psychobiological nature of these bodily-based phenomena models of human development, from infancy throughout the lifespan (Schore, 2003a). By 2007 the editor of the journal *Motivation and Emotion* was asserting, 'After three decades of the dominance of cognitive approaches, motivational and emotional processes have roared back into the limelight' (Ryan, 2007, p. 1).

This dictum also applied to developmental theory. Previous developmental psychological models had focused on the emergence of more complex *cognition* late in the first and into the second year of infancy. The significant increase in current knowledge regarding early human *relationships* clearly demonstrates that, from the very beginning, the developing human is *emotionally* relating with the *social environment*, moving the emphasis from cognitive to emotional development. The concept of the 'primacy of affect' has also impacted on the concept of 'mental health' and its earliest expression as 'infant mental health'. Reflecting the paradigm shift, updated models of psychological wellbeing are now grounded not in cognitive but emotional wellbeing. For an overview of my more recent interdisciplinary studies of emotional development and the relational origins of emotional wellbeing, I refer the reader to Schore (2012a, 2012b, 2013a).

The second theme of the paradigm shift is the converging interest in a theoretical organising principle that lies at core of every biological and psychological discipline – *self-regulation,* an essential mechanism of emotional processes. Again, at the very beginning of my studies, in *Affect regulation and the origin of the self: The neurobiology of emotional development*, I offered a psychoneurobiological model of emotional attachment dynamics centred in self-regulation (Schore, 1994). Applying this construct to developmental psychology as a whole, Fonagy and Target boldly concluded in 2002 that the whole of child development can be basically conceptualised as the enhancement of self-regulation. By this time both scientists and mental health workers shared a common interest in affect and affect regulation (Schore, 2003a, 2003b). In 2008 Judith Schore and I offered a succinct explication of 'modern attachment theory':

> We suggest that in line with Bowlby's fundamental goal of the integration of psychological and biological models of human development, the current clinical and experimental focus on how affective bodily-based processes are nonconsciously interactively regulated . . . has shifted attachment theory to a regulation theory. (J. Schore & A. Schore, 2008, p. 9)

Since that time, my ongoing studies have offered interpersonal neurobiological models of the underlying mechanisms by which attachment promotes self-regulation, and how this emergent function allows, in turn, new and more complex and resilient relational interactions between the individual

and the social environment. From infancy and throughout all later stages of the lifespan, spontaneous, rapidly acting emotional processes are centrally involved in enabling the organism to regulate, and thereby cope with stresses and challenges, and are thus involved in emotional resilience and wellbeing.

The third theme of paradigm shift is reflected in the previously mentioned explosion of developmental neuroscience research, especially in *developmental affective neuroscience*, and particularly studies of prenatal, perinatal and postnatal stages that occur within the human brain growth spurt, the last trimester of pregnancy through the second year. The number of studies exploring the earliest stages of rapid dynamic brain development has significantly expanded, demonstrating that the rate of synaptogenesis in the developing infant's brain is a remarkable 40,000 new synapses every second, and that brain volume increases from 400 g at birth to 1000 g at 12 months. Furthermore, studies on early brain lateralisation reveal that during this period the right brain develops before the left, which does not begin its growth spurt until the second year. Most importantly, the unfolding of epigenetic programs that guide early brain development over the perinatal and postnatal stages of human infancy occur within mother–infant attachment transactions. Indeed, a body of research supports the idea that attachment transactions influence the 'early life programming of hemispheric lateralization' (Stevenson, Halliday, Marsden, & Mason, 2008) that, in turn, generates the dominance of the right hemisphere in the first year of life (Chiron et al., 1997). In this manner, attachment interactions during critical periods of maturation of the early developing right brain indelibly affect the trajectory of later social-emotional development.

What had been theoretical proposals only two decades earlier are now accepted developmental organising principles as a result of the paradigm shift:

> A complex, dynamic story is unfolding of evolutionarily conserved genetic programs that guide mammalian brain development and how our *in utero* and our early postnatal interpersonal worlds shape and mold the individuals (infants, children, adolescents, adults and caregivers) we are to become. (Leckman & March, 2011, p. 333)

The interpersonal worlds that shape and fine-tune early brain development represent the interpersonal neurobiological underpinnings of essential adaptive functions of the early maturing right brain, and thereby an enduring capacity of emotional wellbeing.

With this introduction in mind, I will discuss briefly very recent interdisciplinary research which further supports regulation theory's assertion that optimal attachment experiences (secure attachment) facilitate the experience-dependent maturation of the developing 'emotional' right brain, and thereby a predisposition for emotional wellbeing in later stages of life. I shall conclude with some thoughts about the application of regulation theory to early intervention and prevention. Throughout, I will also describe the progression of my work in developmental neuroscience over the past two decades. Here, as in all my writings, I continue to use the device of citing verbatim the current voices of clinicians studying the mind and neuroscientists studying the brain, in order to demonstrate their agreement on the centrality of bodily-based affective phenomena, and to generate a common language that addresses the subjective emotional realm, including emotional wellbeing.

Optimal Attachment Experiences and the Early Relational Origins of Emotional Wellbeing

Modern attachment theory offers an updated account of John Bowlby's fundamental goal of integrating psychological and biological conceptions of human development. In his seminal first volume he proposed that mother–infant attachment communications are 'accompanied by the strongest of feelings and emotions, and occur within a context of facial expression, posture, tone of voice' (Bowlby, 1969, p. 120). Following Bowlby's lead, in my first book I suggested that, during attachment episodes of *visual–facial, auditory–prosodic* and *tactile–gestural* affective communications, the primary care giver regulates the infant's internal states of peripheral and central arousal.

> The infant's early maturing right hemisphere, which is dominant for the child's processing of visual emotional information, the infant's recognition of the mother's face, and the perception of arousal-inducing maternal facial expressions, is psychobiologically attuned to the output of the mother's right hemisphere, which is involved in the expression and processing of emotional information and in nonverbal communication. (Schore, 1994, p. 63)

In order to process these non-verbal communications, the infant seeks proximity to the mother, who in an optimal context must be subjectively perceived as predictable, consistent and emotionally available. During dyadic attachment transactions, the sensitive primary care giver's right brain implicitly attends to, perceives (recognises), appraises and regulates non-verbal expressions of the infant's more and more intense states of positive and negative affective arousal. This model was consonant with an early exposition of Porges' polyvagal theory, also dating from 1994, that posited the face and voice are powerful conduits through which safety is communicated between the mother and infant, and that 'the right hemisphere—including the right cortical and subcortical structures—would promote the efficient regulation of autonomic function via the source nuclei of the brain stem' (Porges, Doussard-Roosevelt, & Maiti, 1994, p. 175).

In 2001 I expanded this model in an article in the *Infant Mental Health Journal*, 'Effects of a secure attachment relationship on right brain development, affect regulation, and infant mental health'. In that work I detailed the

neurobiology of a secure attachment, an exemplar of adaptive infant mental health, and focused upon the primary care giver's psychobiological regulation of the infant's maturing right-lateralised limbic–autonomic circuits. I asserted, 'adaptive infant mental health can be fundamentally defined as the earliest expression of flexible strategies for coping with the novelty and stress that is inherent in human interactions. This efficient right brain function is a resilience factor for optimal development over the later stages of the life cycle' (Schore, 2001a, p. 7). Linking that paper to the theme of this one, infant mental health describes the first expression of an enduring subjective sense of emotional wellbeing. The emergent right brain functions of emotional wellbeing are thus forged in optimal right brain-to-right brain attachment communications in the first 2 years of life.

Since 2001 a large body of developmental neurobiological research has supported the hypothesis that the attachment mechanism is embedded in infant–care giver right brain-to-right brain affective transactions. Here I offer an overview of current research on rapid, spontaneous, implicit *visual–facial, auditory–prosodic* and *tactile–gestural* affective communications in early development. These studies are organised as a temporal sequence over the course of the first year, and they represent the ontogeny of emotional wellbeing over that period. Due to space limitations I refer the reader to Schore (2012a, 2013a, 2014a) for specific references to the following.

Attachment and the Development of the Infant Right Brain over the First Year

With respect to *visual–facial attachment communications*, it is now well established that mutual gaze is critical to early social development. The emergence of the capacity to process information from faces efficiently requires visual input to the right (and not left) hemisphere during infancy. At 2 months of age, the onset of a critical period during which synaptic connections in the developing occipital cortex are modified by visual experience, infants show right hemispheric activation when exposed to a woman's face. Using electroencephalogram (EEG) methodology, Grossmann, Johnson, Farroni and Csibra (2007) report that 4-month-old infants presented with images of a female face gazing directly ahead show enhanced gamma electrical activity over right prefrontal areas. Near-infrared spectroscopy (NIRS) research (perhaps the most suitable of all neuroscience techniques applicable to human infants) reveals that, specifically, the 5-month-old's right hemisphere responds to images of adult female faces. By 6 months infants show a right lateralised, left gaze bias when viewing faces, right temporal activation when looking at angry faces, and significantly greater right frontotemporal activation when viewing their own mother's (as opposed to a stranger's) face. Note the developmental progression over the first year to more complex visual-affective functions. These research data indicate that the future capacity to process the essential social information expressed in face-to-face communications, a central aspect of emotional wellbeing, is dependent upon care giver–infant eye contact and visual gazing during early critical periods.

Ongoing studies of prenatal, perinatal and postnatal *auditory–prosodic attachment communications* also highlight the role of the right brain. In an EEG study of auditory pitch processing in preterm infants born at 30 gestational weeks, Mento, Suppiej, Altoe and Bisiacchi (2010) conclude, 'the earlier right structural maturation in foetal epochs seems to be paralleled by a right functional development' (p. 1). A functional magnetic resonance imaging (MRI) study of 1- to 3-day-old newborns reports that music (such as in lullabies) evokes right hemispheric activation in the auditory cortex. Using NIRS with 2- to 6-day-old neonates, Telkemeyer et al. (2009) observe, 'responses to slow acoustic modulations are lateralized to the right hemisphere' (p. 14726). This same optical brain imaging technology reveals that prosodic processing of emotional voices in 3-month-old and 4-month-old infants activates the right temporoparietal region. Grossmann, Oberecker, Koch, and Friederici (2010) report that 7-month-old infants respond to emotional voices in a voice-sensitive region of the right superior temporal sulcus, and happy prosody specifically activates the right inferior frontal cortex. These authors conclude, 'The pattern of findings suggests that temporal regions specialize in processing voices very early in development and that, already in infancy, emotions differentially modulate voice processing in the right hemisphere" (p. 852).

Furthermore, current neuroscience supports the principle that the care giver's use of infant-directed speech ('motherese') is critical for the development of the posterior areas of the right hemisphere that process prosodic-emotional functions. Independent of culture, infant-directed speech is preferred over adult-directed speech as early as a few weeks after birth. Compared to adult-directed speech, motherese, the vocal expression of emotion to infants, is higher in pitch, has a wider pitch range and exhibits exaggerated pitch contours. In addition, it is shorter, slower and separated by longer pauses than adult speech. Developmental neurobiological research demonstrates that maternal infant-directed speech activates the right temporal area of 4- to 6-month-old infants, and that this activation is even greater in 7- to 9-month-old infants. In 11-month-old infants, the voice of a woman's infant-directed speech (i.e., with somewhat exaggerated prosody) elicits a right-lateralised event-related potential. Thus, the emotional quality of what infants hear in the early stages of infancy affects the development of the voice-processing areas of the right hemisphere, especially the temporal voice areas in the upper banks of the right superior temporal sulcus. The mother's use of infant-directed speech imprints the circuits of the infant's right temporal areas, and in this manner her voice has enduring effects. Again, note the developmental progression of auditory affective functions that allows for more complex communication. The burgeoning ability of reading the emotional tone of the voice of others is an essential element of all later

social relationships and thereby an enduring subjective state of emotional wellbeing.

In terms of *tactile–gestural attachment communications*, Sieratzki and Woll (1996) describe the effects of touch on the developing right hemisphere, and assert that the emotional impact of touch is more direct and immediate if an infant is held to the left side of the body (see studies of 'left-sided cradling', Bourne & Todd, 2004; Hendriks, van Rijswijk, & Omtzigt, 2011). Clinical research demonstrates the essential role of maternal 'affective touch' on human infant development in the first year of life. This allows the infant and mother to create a system of 'touch synchrony' in order to alter vagal tone and cortisol reactivity. The dyad thus uses 'interpersonal touch' as a communication system, especially for the communication and regulation of emotional information. Other studies report that high levels of tactile stimulation and mutual touch occur in breastfeeding, and an increase in EEG amplitude in right posterior cortical areas in 6-month-old infants during the intense somatosensory tactile contact of breastfeeding. This research supports the infant's need for affectionate touch for healthy right hemisphere development and emotional wellbeing.

Confirming this model of the critical importance of right brain-to-right attachment communications in the progressive social experience-dependent lateralisation of the right brain, neuroscientists now document that the right brain hemisphere is dominant in human infants, that the strong and consistent predominance for the right hemisphere emerges postnatally, and that the mother's right hemisphere is more involved than the left in emotional processing and mothering. Studying structural connectivity asymmetry in the perinatal brain with newborn infants *at the beginning of the first year*, Michael Meaney and his colleagues conclude,

> [I]n early life the right cerebral hemisphere could be better able to process . . . emotion (Schore, 2000; Wada and Davis, 1977). This idea appears consistent with our findings of rightward asymmetry in . . . limbic structures . . . These neural substrates function as *hubs in the right hemisphere for emotion processes and mother and child interaction.* (Ratnarajah et al., 2013, p. 193, my italics)

Tronick's studies of infants *in the middle of the first year* demonstrate that 6-month-old infants use left-sided gestures generated by the right hemisphere in order to cope with the stressful face-to-face still-face paradigm. They interpret these data as being 'consistent with Schore's (2005) hypotheses of hemispheric right-sided activation of emotions and their regulation during infant–mother interactions' (Montirosso, Cozzi, Tronick, & Borgatti, 2012, p. 826). Using near-infrared spectroscopy, Minagawa-Kawai's study of infant–mother attachment *at the end of the first year* states, 'Our results are in agreement with that of Schore (2000) who addressed the importance of the right hemisphere in the attachment system' (Minagawa-Kawai et al., 2009, p. 289).

As the securely attached infant enters toddlerhood in the second year, his or her interactively regulated right brain visual–facial, auditory–prosodic and tactile–gestural communications become holistically integrated, allowing for the emergence of a coherent right brain emotional and corporeal implicit self-system. As mentioned in the beginning of this article, an essential function of the right brain subjective self is to unconsciously generate a background sense of emotional wellbeing, an implicit sense of security that operates beneath levels of conscious awareness. Like myself, the pre-eminent Australian psychiatrist Russell Meares posits that 'The right side of the brain seems to be more involved than the left in the creation of an "inner," emotionally laden experience', and that the right brain self-system generates 'a *background state of well-being*' (Meares, 2012, p. 296).

Ongoing neuroscience research continues to describe the adaptive social–emotional functions of the right brain. According to Decety and Chaminade, 'self-awareness, empathy, identification with others, and more generally intersubjective processes are largely dependent upon . . . right hemisphere resources, which are the first to develop' (Decety & Chaminade, 2003, p. 591). At all later stages of human development 'The neural substrates of the perception of voices, faces, gestures, smells, and pheromones, as evidenced by modern neuroimaging techniques, are characterized by a general right-hemispheric functional asymmetry' (Brancucci, Lucci, Mazzatenta, & Tommasi, 2009, p. 895). This perception of emotional stimuli takes place within a social context. In a very recent overview of brain laterality research, Hecht asserts, 'Mounting evidence suggests that the right hemisphere has a relative advantage over the left hemisphere mediating social intelligence—identifying social stimuli, understanding the intentions of other people, awareness of the dynamics in social relationships, and successful handling of social interactions' (Hecht, 2014, p. 1). Social relationships are also contexts for right brain-to-right brain interactive regulation. A large body of studies indicates that over the lifespan the right, and not left, lateralised prefrontal regions are responsible for the most complex regulation of affect and stress (Cerqueira, Almeida, & Sousa, 2008; Czeh, Perez-Cruz, Fuchs, & Flugge, 2008; A. Schore, 1994, 2003a, 2003b; 2012; Sullivan & Gratton, 2002; Wang et al., 2005).

Furthermore, my work in neuropsychoanalysis suggests that the right brain represents the biological substrate of the human unconscious. Writing in the neuropsychoanalytic literature on 'Emotions, unconscious processes, and the right hemisphere' Gainotti concludes:

> [T]he right hemisphere subserves the lower 'schematic' level (where emotions are automatically generated and experienced as 'true emotions') whereas the left hemisphere the higher 'conceptual' level (where emotions are consciously analysed and submitted to intentional control. (Gainotti, 2006, p. 71)

In accord with this model of emotional wellbeing Greenberg (2007) cites my work in his description of a fundamental implicit affect regulatory process performed by the right

hemisphere that rapidly and automatically processes facial expression, vocal quality and eye contact in a relational (social) context. In light of the fact that the right hemisphere is dominant for the non-verbal, holistic processing of emotional information and social interactions (Decety & Lamm, 2007; Semrud-Clikeman, Fine, & Zhu, 2011), neuroscience thus suggests that the often used concept of 'emotional wellbeing' is more properly characterised as 'social–emotional wellbeing'.

Optimisation of Emotional Wellbeing: Psychotherapy, Early Intervention and Prevention

In marked contrast to the earlier described optimal growth-facilitating attachment scenario, in a relational growth-inhibiting early environment of attachment trauma (abuse and/or neglect), the primary care giver of an insecure disorganised–disoriented infant induces traumatic states of enduring negative affect in the child (Schore, 2001b, 2003b). This caregiver is too frequently emotionally inaccessible and reacts to her infant's expressions of stressful affect inconsistently and inappropriately (massive intrusiveness or massive disengagement), and therefore shows minimal or unpredictable participation in the relational arousal-regulating processes. Instead of modulating, she induces extreme levels of stressful stimulation and arousal, very high in abuse and/or very low in neglect. Because she provides little interactive repair, the infant's intense negative affective states are long lasting. This enduring state of emotional distress associated with early relational trauma and insecure attachment is in contrast to the enduring background state of emotional wellbeing associated with more secure attachment histories.

With regard to the theme of this conference, 'Childhood Trauma: Understanding the Basis of Change and Recovery', regulation theory also offers a coherent, heuristic and clinically relevant theory of how attachment trauma alters human emotional and social development. In my early contributions to this effort in 1994, I proposed that the mother–infant attachment relationship impacts the developing right hemisphere *for better or worse*, and can either facilitate resilience to stress (emotional wellbeing) or create a predisposition to emotional dysregulation and thereby psychopathology. In a companion article in the previously mentioned 2001 edition of the *Infant Mental Health Journal*, I suggested that intense and enduring stress created in high-risk contexts of *relational trauma* represented social environments that generated not attachment regulation but dysregulation, as well as little play and unpredictable or inconsistent interactive repair (Schore, 2001b).

Soon afterwards, in 2002, I published 'Dysregulation of the right brain: a fundamental mechanism of traumatic attachment and the psychopathogenesis of posttraumatic stress disorder' in the *Australian and New Zealand Journal of Psychiatry*. In that work I delineated how relational trauma in early critical periods of brain development imprints a permanent physiological reactivity of the right brain, a predisposition for the characterological use of pathological dissociation, and a susceptibility to later disorders of affect regulation expressed in a deficit in coping with future social–emotional stressors. This deficit in right brain functions is manifest as an inefficient capacity for emotional wellbeing and resilience, especially at moments of relational, social stress. Since then, I have continued to offer both clinical and research studies that articulate the early interpersonal neurobiological origins of all psychiatric and personality disorders (for my more recent theoretical and clinical work on trauma and dissociation, see Schore, 2009b, 2012a, 2013b).

Psychotherapy as a Relational Intervention that Promotes Emotional Wellbeing

In my latest book, *The science of the art of psychotherapy* (Schore, 2012a), I continue to elaborate an evidence-based clinical model that explicates the change mechanisms involved in not only reducing symptomatic behaviour and negative cognitions, but also in promoting emotional wellbeing. Referring to patients with histories of relational trauma (borderline personality disorder) my colleague Russell Meares observes,

> [T]he fundamental experience of self is a right-hemispheric affair . . . when right-hemispheric function is diminished, so also are those features associated with the overarching concepts of self, including inhibitory control and a *background state of well-being*. (Meares, 2012, p. 296, my italics)

My ongoing studies in regulation theory attempt to update treatment models of psychotherapy with developmentally traumatised patients. All personality and psychiatric disorders represent disturbances of right brain intersubjectivity and affect regulation. An essential clinical principle of working with relational trauma and severe disturbances of affect regulation is that the empathic therapist helps the patient to re-experience relational trauma in affectively tolerable doses in the context of a safe environment, so that the overwhelming traumatic feelings can be regulated and adaptively integrated into patient's emotional life (see my chapter on enactment in Schore, 2012a). The focus of treatment is not on retrieving an explicit memory of attachment trauma in the first year, but on the effects of early relational trauma on 'character structure', and deficits in adaptive right brain functions.

In accordance with a relational psychodynamic model of psychotherapy, right brain processes that are reciprocally activated on both sides of the therapeutic alliance lie at the core of the psychotherapeutic change process (J. Schore, 2012). Meares (2012) describes 'a form of therapeutic conversation that can be conceived . . . as a dynamic interplay between two right hemispheres'. In these emotionally charged therapeutic encounters, the therapist's right brain visual–facial, auditory–prosodic and tactile–gestural capacities for the non-verbal communication and regulation of the patient's emotional self-states are critical to the change process

of psychotherapy (Schore, 2003a, Chapter 3). Ogden, Pain, Minton and Fisher (2005) conclude that the psychotherapy change mechanism is not in verbal language exchanges but in the empathic clinician's *background*, implicit psychobiologically attuned, interactive affect regulation, a relational context that allows the patient to safely contact, describe and regulate his/her inner subjective experience.

In working with patients who present with early right brain attachment trauma, therapeutic expertise is expressed not so much in uncovering verbal content by left brain interpretations that promote cognitive understanding, but rather as the clinician's relational psychobiological capacities in implicit right brain emotional and social functions. My ongoing studies continue to suggest that change in trauma therapy is not an analytic left brain 'talking cure' but a right brain 'relational affect communicating and regulating cure' (for the latest update of this model, see Schore, 2014b, 'The right brain is dominant in psychotherapy', and J. Schore & A. Schore, 2014, 'Regulation theory and affect regulation therapy: A clinical primer'). Thus, effective affect regulation therapy with infant, child, adolescent and adult patients can act as a growth-facilitating environment that alters the right brain, and thereby potentially promotes a more secure sense of emotional wellbeing. In line with current relational trends in psychotherapy, note that wellbeing is more than an intrapersonal intrapsychic function, but also an interpersonal intersubjective phenomenon.

Early Intervention, Prevention and the Promotion of Emotional Wellbeing

My most recent writings on the interpersonal neurobiology of attachment and brain development have emphasised that early intervention during the human brain growth spurt, a period of maximal neuroplasticity, can also optimise the development of right brain emotional wellbeing. Developmental neuroscientists are now concluding,

> The large increase in total brain volume in the first year of life suggests that this is a critical period in which disruption of developmental processes, as the result of innate genetic abnormalities or as a consequence of environmental insults, may have long-lasting or permanent effects on brain structure and function . . . Although the first year of life may be a period of developmental vulnerability, *it may also be a period in which therapeutic interventions would have the greatest positive effect.* (Knickmeyer et al., 2008, pp. 12179–12180, my italics)

Congruent with this proposal, researchers studying the developmental neurobiological basis of human attachment are asserting that 'Understanding the motivational basis for healthy and at-risk parenting may open new theoretical vistas and clinical opportunities and may lead to the construction of more specific interventions that can target disruptions to maternal–infant bonding at an earlier stage and in a more accurate manner' (Atzil, Hendler, & Feldman, 2011, p. 11). Towards that end, in a recent overview of the field, I described an ongoing trend:

> Recent models of early life trauma are altering their focus from deficits in later maturing conscious, verbal, explicit and voluntary behavior, to impairments of early maturing nonconscious, nonverbal, implicit and automatic adaptive social emotional functions. Developmental neuroscience is now moving from studies of later maturing left brain conscious verbal cognitive processes into the early preverbal development of adaptive emotion processing right brain systems in pre- and postnatal periods. (Schore, 2010, p. 144)

This description of the paradigm shift applies equally to clinical assessments of the early origins of emotional disturbance as well as emotional wellbeing.

For some time I have been putting forth the argument that the mental health field needs to move more deeply into early prevention programs anchored in developmental neuroscience, especially affective neuroscience (Schore, 2001c). With this in mind, in a number of current publications in both the clinical and research literatures I am using regulation theory as a guide for formulating early assessments of secure and insecure mother–infant attachment relationships (Schore, 2012a, 2013a, 2014b; Schore & Newton, 2012). The previously described temporal sequence of rapid, spontaneous, implicit visual–facial, auditory–prosodic and tactile–gestural affective communications over the first year represents a source generator of evidence-based assessments of developing right brain functions. This early intervention also includes evaluations of the dyadic attachment relationship's increasing regulatory and intersubjective functions, and thereby the ontogeny of the infant's emotional wellbeing over that period. In parallel, I am also applying the theory to the assessment of the early stages of autism, a neurodevelopmental disorder characterised by significant alterations of evolving social and emotional functions of the early developing right brain. These severe deficits are expressed as profound intersubjective deficits and disturbances in interactive affect regulation in autistic infant–mother dyads (Schore, 2013a, 2014a), a poor interpersonal context for the generation of an enduring subjective sense of emotional wellbeing.

At the beginning of this article. I described the excitement in developmental neuroscience prompted by current studies on the impact of early maternal care on brain development, 'one of the most important discoveries in all of science that have major implications for our field'. The groundbreaking advances in our understanding of the science of early development have larger implications for cultural and political systems as well as for family law (Schore & McIntosh, 2011). In a current editorial in the journal *Science* titled 'A focus on child development', Silver and Singer describe the wider economic implications of early brain research for the development of not only the individual, but also the culture:

> Recent advances in neuroscience indicate the importance of healthy brain development in the early years to human capital formation . . . Investing in child development is the foundation for improved health, economic, and social outcomes. Not getting the early years 'right' is linked to violent

> behavior, depression, higher rates of noncommunicable disease, and lower wages, and it negatively affects a nation's gross domestic product. (Silver & Singer, 2014, p. 120)

I'd add that, in the very earliest critical periods of child development, investing in 'healthy brain development' can optimise the attachment-driven experience-dependent maturation of the right brain and thereby maximise the relational origins of emotional wellbeing across larger numbers of individuals within any particular culture.

In a recent UNICEF report, *Child well-being in rich countries* (UNICEF, 2013), the international authors describe the essential importance of early intervention and prevention:

> It is perhaps no longer necessary to argue the case for the importance of the early years. Advances in both neuroscience and social science have repeatedly confirmed that it is at this time that genetic potential interacts in infinitely complex ways with early experience to construct the neural pathways and connections that quickly become both the foundations and the scaffolding for all later development . . . It is therefore at this time that the child's *wellbeing, health and development* are most in need of society's concern and protection. (UNICEF, 2013, p. 34, my italics)

In light of the current paradigm shift across disciplines from behaviour, to cognition, to bodily-based emotion, a society's support of early intervention and prevention programs should focus less on assessments of later-evolving left brain executive functions and the development of cognitive and language skills, and instead focus more on early evolving right brain social and emotional wellbeing.

References

Atzil, S., Hendler, T., & Feldman, R. (2011, 31 August). Specifying the neurobiological basis of human attachment: Brain, hormones, and behavior in synchronous and intrusive mothers. *Neuropsychopharmacology*. doi:10.1038/npp.2011.172.

Bourne, V. J., & Todd, B. K. (2004). When left means right: An explanation of the left cradling bias in terms of right hemisphere specializations. *Developmental Science*, *7*, 19–24.

Bowlby, J. (1969). *Attachment and loss. Vol. 1: Attachment*. New York: Basic Books.

Brancucci, A., Lucci, G., Mazzatenta, A., & Tommasi, L. (2009). Asymmetries of the human social brain in the visual, auditory and chemical modalities. *Philosophical Transactions of the Royal Society of London Biological Sciences*, *364*, 895–914.

Cerqueira, J. J., Almeida, O. F. X., & Sousa, N. (2008). The stressed prefrontal cortex. Left? Right! *Brain, Behavior, and Immunity*, *22*, 630–638.

Chiron, C., Jambaque, I., Nabbout, R., Lounes, R., Syrota, A., & Dulac, O. (1997). The right brain hemisphere is dominant in human infants. *Brain*, *120*, 1057–1065.

Czeh, B., Perez-Cruz, C., Fuchs, E., & Flugge, G. (2008). Chronic stress-induced cellular changes in the medial prefrontal cortex and their potential clinical implications: Does hemisphere location matter? *Behavioral Brain Research*, *190*, 1–13.

Decety, J., & Chaminade, T. (2003). When the self represents the other: A new cognitive neuroscience view on psychological identification. *Consciousness and Cognition*, *12*, 577–596.

Decety, J., & Lamm, C. (2007). The role of the right temporoparietal junction in social interaction: How low-level computational processes contribute to meta-cognition. *The Neuroscientist*, *13*, 580–593.

Fonagy, P., & Target, M. (2002). Early intervention and the development of self-regulation. *Psychoanalytic Inquiry*, *22*, 307–335.

Gainotti, G. (2006). Unconscious emotional memories and the right hemisphere. In M. Mancia (Ed.), *Psychoanalysis and neuroscience* (pp. 151–173). Milan: Springer Milan.

Greenberg, L. S. (2007). Emotion coming of age. *Clinical Psychology Science and Practice*, *14*, 414–421.

Grossmann, T., Johnson, M. H., Farroni, T., & Csibra, G. (2007). Social perception in the infant brain: Gamma oscillatory activity in response to eye gaze. *Social Cognitive and Affective Neuroscience*, *2*, 284–291.

Grossmann, T., Oberecker, R., Koch, S. P., & Friederici, A. D. (2010). The developmental origins of voice processing in the human brain. *Neuron*, *65*, 852–858.

Hecht, D. (2014). Cerebral lateralization of pro- and anti-social tendencies. *Experimental Neurobiology*, *23*, 1–27.

Hendriks, A. W., van Rijswijk, M., & Omtzigt, D. (2011). Holding-side influences on infant's view of mother's face. *Laterality*, *16*, 641–655.

Knickmeyer, R. C., Gouttard, S., Kang, C., Evans, D., Wilber, K., Smith, J. K., . . . Gilmore, J. H. (2008). A structural MRI study of human brain development from birth to 2 years. *Journal of Neuroscience*, *28*, 12176–12182.

Leckman, J. F., & March, J. S. (2011). Editorial: Developmental neuroscience comes of age. *Journal of Child Psychology and Psychiatry*, *52*, 333–338.

Meares, R. (2012). *A dissociation model of borderline personality disorder*. New York: W.W. Norton.

Mento, G., Suppiej, A., Altoe, G., & Bisiacchi, P. S. (2010). Functional hemispheric asymmetries in humans: Electrophysiological evidence from preterm infants. *European Journal of Neuroscience*, *31*, 565–574.

Minagawa-Kawai, Y., Matsuoka, S., Dan, I., Naoi, N., Nakamura, K., & Kojima, S. (2009). Prefrontal activation associated with social attachment: facial-emotion recognition in mothers and infants. *Cerebral Cortex*, *19*, 284–292.

Montirosso, R., Cozzi, P., Tronick, E., & Borgatti, R. (2012). Differential distribution and lateralization of infant gestures and their relation to maternal gestures in the Face-to-Face Still-Face paradigm. *Infant Behavior and Development*, *35*, 819–828.

Ogden, P., Pain, C., Minton, K., & Fisher, J. (2005). Including the body in mainstream psychotherapy for traumatized individuals. *Psychologist–Psychoanalyst*, *25*, 19–24.

Porges, S. W., Doussard-Roosevelt, J. A., & Maiti, A. K. (1994). Vagal tone and the physiological regulation of emotion.

Monographs of the Society for Research in Child Development, *59*, 167–186.

Ratnarajah, N., Rifkin-Graboi, A., Fortier, M. V., Chong, Y. S., Kwek, K., Saw, S-M., . . . Qui, A. (2013). Structural connectivity in the neonatal brain. *Neuromage*, *75*, 187–194.

Ryan, R. (2007). Motivation and emotion: A new look and approach for two reemerging fields. *Motivation and Emotion*, *31*, 1–3.

Schore, A. N. (1994). *Affect regulation and the origin of the self*. Mahweh, NJ: Erlbaum.

Schore, A. N. (2000). Attachment and the regulation of the right brain. *Attachment and Human Development*, *2*, 23–47.

Schore, A. N. (2001a). The effects of a secure attachment relationship on right brain development, affect regulation, and infant mental health. *Infant Mental Health Journal*, *22*, 7–66.

Schore, A. N. (2001b). The effects of relational trauma on right brain development, affect regulation, and infant mental health. *Infant Mental Health Journal*, *22*, 201–269.

Schore, A. N. (2001c). Contributions from the decade of the brain to infant mental health: An overview. *Infant Mental Health Journal*, *22*, 1–6.

Schore, A. N. (2002). Dysregulation of the right brain: a fundamental mechanism of traumatic attachment and the psychopathogenesis of posttraumatic stress disorder. *Australian and New Zealand Journal of Psychiatry*, *36*, 9–30.

Schore, A. N. (2003a). *Affect regulation and the repair of the self*. New York: W.W. Norton.

Schore, A. N. (2003b). *Affect dysregulation and disorders of the self*. New York: W.W. Norton.

Schore, A. N. (2009a, 8 August). The paradigm shift: The right brain and the relational unconscious. Invited plenary address to the American Psychological Association 2009 Convention, Toronto, Canada. Retrieved from http://www.allanschore.com/pdf/SchoreAPAPlenaryFinal09.pdf

Schore, A. N. (2009b). Relational trauma and the developing right brain. An interface of psychoanalytic self psychology and neuroscience. *Annals of the New York Academy of Sciences*, *1159*, 189–203.

Schore, A. N. (2010). Synopsis of Section on 'Biological approaches to early life trauma'. In R. A. Lanius, E. Vermetten & C. Pain (Eds.), *The impact of early life trauma on health and disease: The hidden epidemic* (pp. 142–147). Cambridge, UK: Cambridge University Press.

Schore, A. N. (2012a). *The science of the art of psychotherapy*. New York: W.W. Norton.

Schore, A. N. (2012b). Bowlby's 'environment of evolutionary adaptedness'. Recent studies on the interpersonal neurobiology of attachment and emotional development. In D. Narvaez, J. Panksepp, A. N. Schore & T. R. Gleason (Eds.), *Evolution, early experience and human development. From research to practice* (pp. 31–73). New York: Oxford University Press.

Schore, A. N. (2013a). Regulation theory and the early assessment of attachment and autistic spectrum disorders: A response to Voran's clinical case. *Journal of Infant, Child, and Adolescent Psychotherapy*, *12*, 164–189.

Schore, A. N. (2013b). Relational trauma, brain development, and dissociation. In J. D. Ford & C. A. Courtois D. (Eds.), *Treating complex traumatic stress disorders in children and adolescents, scientific foundations and therapeutic models* (pp. 3–23). New York: Guilford Press.

Schore, A. N. (2014a). Early interpersonal neurobiological assessment of attachment and autistic spectrum disorders. *Frontiers in Psychology*, *5*, article 1049. doi: 10.3389/fpsyg.2014.01049.

Schore, A. N. (2014b). The right brain is dominant in psychotherapy. *Psychotherapy*, *51*, 388–397.

Schore, A. N., & McIntosh, J. (2011). Family law and the neuroscience of attachment, Part l. *Family Court Review*, *49*, 501–512.

Schore, A. N., & Newton, R. P. (2012). Using modern attachment theory to guide clinical assessments of early attachment relationships. In J. E. Bettmann & D. Friedman (Eds.), *Attachment-based clinical work with children and adolescents* (pp. 61–96). New York: Springer.

Schore, J. (2012). Using concepts from interpersonal neurobiology in revisiting psychodynamic theory. *Clinical Social Work Journal*, *82*, 90–111.

Schore, J., & Schore, A. (2008). Modern attachment theory: The central role of affect regulation in development and treatment. *Clinical Social Work Journal*, *36*, 9–20.

Schore, J., & Schore, A. (2014). Regulation theory and affect regulation psychotherapy: A clinical primer. *Smith College Studies in Social Work*, *84*, 178–195.

Semrud-Clikeman, M., Fine, J. G., & Zhu, D. C. (2011). The role of the right hemisphere for processing of social interactions in normal adults using functional magnetic resonance imaging. *Neuropsychobiology*, *64*, 47–51.

Sieratzki, J. S., & Woll, B. (1996). Why do mothers cradle their babies on the left? *Lancet*, *347*, 1746–1748.

Silver, K. L., & Singer, P. A. (2014). Editorial: A focus on child development. *Science*, *345*, 120.

Stevenson, C. W., Halliday, D. M., Marsden, C. A., & Mason, R. (2008). Early life programming of hemispheric lateralization and synchronization in the adult medial prefrontal cortex. *Neuroscience*, *155*, 852–863.

Sullivan, R. M., & Gratton, A. (2002). Prefrontal cortical regulation of hypothalamic–pituitary–adrenal function in the rat and implications for psychopathology: Side matters. *Psychoneuroendocrinology*, *27*, 99–114.

Telkemeyer, S., Rossi, S., Koch, S. P., Nierhaus, T., Steinbrink, J., Poeppel, D., . . . Wartenburger, I. (2009). Sensitivity of newborn auditory cortex to the temporal structure of sounds. *Journal of Neuroscience*, *29*, 14726–14733.

UNICEF. (2013). *Child well-being in rich countries: A comparative overview*, Innocenti Report Card 11. Florence: UNICEF Office of Research.

Wada, J. A., & Davis, A. E. (1977). Fundamental nature of human infant's brain asymmetry. *Canadian Journal of Neurological Sciences, 4*, 203–207.

Wang, J., Rao, H., Wetmore, G. S., Furlan, P. M., Korczykowski, M., Dinges, D. F., & Detre, J. A. (2005). Perfusion functional MRI reveals cerebral blood flow pattern under psychological stress. *Proceedings of the National Academy of Sciences of the United States of America, 102*, 17804–17809.

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