

**Neuroscience and the 'law of the self': the autonomic nervous system
updated, re-mapped and in relationship' by Roz Carroll, in:**

New Dimensions in Body Psychotherapy (2005) N. Totton (ed) Maidenhead: Open University Press

There is currently an explosion of interest in the field of body psychotherapy. This is feeding back into psychotherapy and counselling in general, with many practitioners and trainees becoming interested in the role of the body in holding and releasing traumatic patterns. This collection of ground-breaking work by practitioners at the forefront of contemporary body psychotherapy enriches the whole therapy world. It explores the leading edge of theory and practice, including: neuroscientific contributions; embodied countertransference; movement patterns and infant development; Freudian and Jungian approaches; continuum movement; embodied-relational therapy process; Work Body-Mind Centering[registered]; developmental somatic psychotherapy; and, trauma work. "New Dimensions in Body Psychotherapy" is an essential contribution to the 'turn to the body' in modern psychotherapy. Contributors include: Jean-Claude Audergon, Katya Bloom, Roz Carroll, Emilie Conrad, Ruella Frank, Linda Hartley, Gottfried Heuer, Peter Levine, Yorai Sella, Michael Soth, Nick Totton, and David Tune.

Neuroscience and the 'law of the self': the autonomic nervous system updated, re-mapped and in relationship

"Reich came to identify Freud's id with the autonomic nervous system [which is] a highly organised and wonderfully co-ordinated physiological system and not a 'seething chaos' as Freud described the id. The appearance of functional rather than structural chaos may appear in the ANS in pathological conditions. (Smith 1989: 118)

Interdisciplinary dialogue

After giving a paper at the recent UKCP Conference 'About a Body' I was asked by a delegate, "Why do you need to turn to neuroscience for confirmation about what you are doing?" I answered that it wasn't confirmation I was seeking, but engagement with the *different perspective* offered by neuroscience. Reich, Perls, Boadella, Keleman, and Boyesen turned to physiology, embryology, morphology, systems theory— science in the mainstream and at the edge - to stimulate their thinking. Indeed many psychotherapists, starting with Freud, have engaged with scientific research in a creative way, just as others have turned to mythology, anthropology, alchemy and the arts. Scientific knowledge is not privileged: it is as provisional, political, and approximate as psychotherapeutic knowledge. But, at this point in history, it is providing a wealth of exciting data-rich and paradigm shifting hypotheses about human functioning. (Carroll 2003)

Neuroscience means 'the study of the nervous system' but it has become an umbrella term for a group of disciplines, including cognitive and experimental psychology, infant observation, psychiatry, physiology, philosophy, neurobiology, neurochemistry, and genetics [\[i\]](#). Schore, Panksepp, Trevarthen, Damasio and others are forging creative bridges between neuroscience and various traditions of psychoanalysis, psychology and social theory. (Carroll 2002b) They present genuinely new models based on a considerable amount of assimilation and contextualisation of theory and raw data, drawing on multiples sources, including hundreds of research papers. Their formulations are interlinked, differing in some details but agreeing on some key ideas: that there is an intrinsic relationship between bodily structure and psychological function; that the brain requires a body to think through and with; and that regulation of affect is the central organising principle of human development and motivation. [\[ii\]](#)

At the cutting edge, neuroscience is making strides towards linking self-object states with specific sub-systems in the brain and the body. Panksepp has looked at intrinsic potentials of the nervous system and identified specific brain circuits, neurochemicals, and motoric patterns relating to seven core affects. (1998) Trevarthen has developed the concept of intersubjectivity with an emphasis on co-ordinated, reciprocal rhythmic patterns of movement, vocalisation and gesture. (2001) Schore proposes that the sense of self emerges from early synchronised energy exchanges between mother and baby which evolve into more complex differentiated interactions. (1994, 2003abc) In great detail he shows how the perception, representation and regulation of bodily and emotional states lies at the heart of human relations. Together these models provide the basis for a 'new anatomy' of body-mind-brain, as a system of systems, with each dimension (autonomic, motoric, peptidergic) mapped more coherently in a relational and developmental context. (Carroll 2004)

The autonomic nervous system (ANS) is a core structure involved in the management of basic body states – that is, the metabolism of energy, the regulation of affect, and the survival and health

of the organism. There has been a spectacular increase in interest in the ANS linked with the emergence of the newly designated area of 'affective neuroscience'. (Panksepp 1998, Schore 1994, Damasio 1994) One of the critical discoveries is that the ANS is not simply autonomous but regulated through interaction with others, and that these interactions are laid down as internalisations at every level of the microstructure of brain and body. (Schore 1994)

An increasing number of therapists are turning to neuroscience to refine and develop the theory and practice of psychotherapy especially in the realm of trauma, attachment, and psychopathology. (De Zulueta 1993; Schore 2003b; Gerhardt 2004) Body psychotherapists have an advantage here in having grown up with a psychotherapeutic model which is grounded in an understanding of the ANS. [\[iii\]](#) Body psychotherapists are trained to observe, attune to and work explicitly with autonomic states in their clients and in themselves. (Totton 2003)

In this chapter I will focus on the ANS - this 'highly organised and wonderfully co-ordinated physiological system' – outlining important developments from neuroscience. It will be a journey into the labyrinth of the complex structures of body-brain, now more fully mapped and elaborated. My emphasis will be not proving the accuracy of models through an accumulation of facts (I invite you to go to my sources, and the sources of those sources for the detail) but rather running and playing with the concepts, metaphors, and possibilities presented mainly in the work of Allan Schore.

The autonomic nervous system regulates emotional-physiological cycles

The physiological operations that we call mind are derived from the structural and functional ensemble [of endocrine, immune, autonomic etc components] rather than from the brain alone. “
(Damasio 1994: xix)

The central nervous system consists of the brain and spinal cord and extends throughout the body via the peripheral nervous system. This is subdivided into the somatic nervous system and the autonomic nervous system. The word 'autonomic' is derived from the Greek *auto* (self) *nomos* (law) hence my favourite translation of this as 'the law of the self', although the usual term is 'self-regulating'. In evolutionary terms the ANS is older than the central nervous system and its anatomical circuitry is broadly dispersed, creating a general response, quite unlike the highly specific pathways and response of the CNS. The somatic nervous system controls musculoskeletal movement, and operates within a feedback loop, which continually sends and receives motor and sensory information between the brain and the body.

The autonomic nervous system has two branches, which regulate the viscera, sense organs, glands, muscles and blood vessels. In standard physiology the two parts of the ANS have been perceived as functioning reciprocally: the sympathetic governing arousal, the fight or flight reaction and the parasympathetic involving relaxation, recuperation and digestion. The sympathetic nervous system is activated by any stimulus over an individual's threshold, which generates an immediate anticipatory state through the release of adrenaline. This causes the heart to beat more quickly and strongly, increases blood supply to the muscles, raises blood pressure, dilates the bronchii and increases the breathing rate, raises the blood sugar level for increased energy, speeds up mental activity, increases tension in the muscles, dilates pupils and increases sweating.

The parasympathetic nervous system comes into operation after the stimulus has been responded to and action taken. It has the opposite effect to sympathetic activity, allowing the body to wind down and re-balance. The activation of the parasympathetic nervous system encourages relaxation of muscles, slowing the heart rate and lowering the blood pressure. It assists the breathing to return to its normal rate, digestive juices flow, bladder and bowels to function, and supports rest, sleep and immune functions.

Since Reich body psychotherapists have recognised the function of the autonomic nervous system as a barometer of emotional intensity and internal conflict. Sympathetic activation has been seen as an indicator of an impulse or a feeling being stirred (*sym pathos* means 'with feeling'.) It is often experienced as a wave of feeling coming *up*— anger, fear, excitement, desire, hatred — which, if expressed, involves movement out, or towards, or in the case of fear, away from, an object. Sympathetic physiology increases energy and readies the body for action — so it is also about the need to do, express, act. Conversely the parasympathetic action is a concomitant of coming *down*—disappointment, grief, shame, guilt, despair; and contentment, peacefulness, satisfaction - feelings which involve a decrease in tension, withdrawal of energy inward and tend more towards introspection. [\[iv\]](#)

The two parts of the ANS together form a self-regulating cycle, but more complex layers of emotional regulation overlay this basic homeostatic template. (Carroll 2000). Body psychotherapy has mapped prototypical cycles in terms of contact quality, changes in blood flow, muscle tension and movement. This model also considers how the cycle is interrupted defensively through habitual patterns and as a result of developmental vicissitudes. (Boyesen 1980)

Tracking of these cycles and their intrapsychic and interpersonal function is at the heart of body psychotherapy, though the specific interventions and models used are quite varied. (Totton 2003) Bodywork which focuses on breathing, sensation, imagery or movement enhances the feedback loop from the peripheral nervous system back to the ANS. Familiarity with the bodily phenomenology – changes in skin colour, muscle tension, pupil size, temperature, pace and feel of movement, conversation, etc – informs body psychotherapy even when the therapist is not consciously formulating the process in such terms. This, as I shall argue later, is a core right brain perceptual skill of body psychotherapy. But it is with the help of neuroscience that we can now elucidate how *any* therapeutic process whether it is verbal or not, explicitly directed towards the body or not, has a relational and autonomic dimension/effect.

	sympathetic	parasympathetic
<i>Summary</i>	arousal, action, outer focus fight/flight	inhibition, inner focus, rest, digestion, repair
	speeding up	slowing down
<i>Standard Physiology</i>	faster breathing (in breath) increases heart rate increases blood.pressure blood goes to muscles increases muscle tension releases glucose for energy pupils dilate pale skin, cold sweating digestion inhibited	slower breathing (out breath) decreases heart rate decreases blood pressure blood to organs & skin relaxes muscle enhances immune function pupils contract/flushing flushed skin, warm blushing increased digestive secretions
<i>Schore's correlations with object relations</i>	amplifying object: 'time moves forward'	inhibiting object: 'time stands still'
<i>Body psychotherapy</i>	feelings that go 'up' - anger, fear, excitement, joy, desire	feelings that go 'down' - shame, sadness, contentment,
<i>Resources Defences</i>	purpose/goal/focus agency projection – push away	reflection/assimilation presence introjection – take in
<i>Response to stress</i>	active coping fight-flight to remove source of stress	passive coping immobility and withdrawal to reduce effects of stress

Allan Schore's tripartite model of regulation

"Spontaneous communication employs [...] expressive displays in the sender that, given attention, activate emotional preattunements and are directly perceived by the receiver [...] This spontaneous communication constitutes a conversation between limbic systems (Buck: 266)

In *Affect Regulation*, a landmark work which spans an incredible breadth of contemporary sciences, Allan Schore links research, metapsychology and clinical data into an overarching theory of development. He makes detailed proposals linking cognitive/ emotional/bodily developmental stages with radical shifts in brain organisation. Sensory information from the environment is processed in a hierarchy of limbic and cortical sites which impact the ANS. Schore focuses on the amygdala, the cingulate and the orbito-frontal cortex, each acting as a representational system, and as a convergence zone for information related to learning from experience. (2003b: 128-177)

The amygdala (active at birth) governs basic survival responses – it attributes an immediate good (safe) or bad (unsafe) valence to sensory information. The cingulate (activated from 3 months) is involved with shared pleasure, motivation, vocalisation and the beginnings of self-other awareness. It stimulates and is stimulated by social interaction. The orbito-frontal cortex is much more complex

in its operations, and its development parallels the critical early phase of separation-individuation (10-18 months).

Relationships between individuals and with the baby are fundamental determining factors of well being or otherwise, which are registered as effects in the infant's body through the activation of the autonomic nervous system.

Body psychotherapy has focussed on processes such as birth, feeding, and the spectrum of early developmental reflexes as central to autonomic organisation. (Boadella 1987, Hartley 1994) Neuroscience has yet to fully integrate this wealth of knowledge but it has paid detailed attention to the mother's face as one of the primary vehicles of regulation of the infant's brain-body showing that 'the 'mere perception of emotion on the [mother's] face generates a resonant emotional state' in her baby. (Beebe & Lachman 2002: 37) In the newborn appraisal and imitation of facial expression is fairly crude, but within months a baby can discriminate among surprise, fear, sadness and make corresponding faces of his or her own. (Meltzoff 1990) At 10 months, the infant seeks out affective information from the partner's face to help them interpret the environment. The expression on the mother's face, and her tone, body posture, and touch all triggers changes in the baby's own autonomic state, the felt body feeling. The baby is responsive to every dimension of change and repeated or particularly intense transactions – traumatic or loving - becoming imprinted in long-term memory. (Schoore 1994)

A is for amygdala

Incoming sensory information from the body goes directly to the amygdala which makes a rapid first assessment of an event, triggering reflex actions such as the startle reflex. Infants have an inborn response to faces with fear or anger which registers immediately via the amygdala. This rapidly activates a strong sympathetic nervous system response correlating with states characterized by immediacy, intensity and reactivity.

Much of the new research into the amygdala has focused on the effect of traumatic events and episodes in childhood and adult life. However Allan Schoore reminds us that the last trimester of pregnancy through to two months of age is the critical period of maturation of the organization of the amygdala with the ANS. Early bonding within hours via smell, taste (breast milk) and touch, and subsequently via eye contact, facial expression and tone of voice, forms the basis for the earliest representation of the relationship with the mother and the basic sense of safety or danger. (Schoore 2003b: 155-7) Apparently unrelated trauma in later life, such as a car crash, can sometimes undo hitherto sufficient defenses against very early vicissitudes in attachment.

Over-activation ('kindling') of the amygdala, accompanied by shutting down of important areas for information processing (hippocampus) and verbalizing (Broca's area) is now seen as a defining signature of trauma. (Scaer 2001) It is becoming a necessary clinical skill to recognize the activation of a trauma response and the potential for dissociation in the client, detectable via autonomic changes. (Rothschild 2000) An amygdala-triggered response in the client can create a feeling of being pulled into a current of intense and chaotic feelings, or a sudden explosive shift in atmosphere. This then informs the decisions the therapist can make in monitoring arousal and enabling any combination of action, discharge, contact, holding or insight that will enhance the safety and effectiveness of the therapy.

Enter the cingulate

The activation of the cingulate at three to nine months, combined with rapid metabolic change in the infant's primary visual cortex at eight weeks, ushers in a new stage which is marked by an increase in sociability. (Schoore 2003b: 139) The cingulate mediates contact and play behaviors, laughing, crying and making faces. (158) By now the infant has formed a discriminate attachment to the mother's face and the cingulate is implicated in the motivation for mother-baby 'proto conversations'. The cingulate supports co-regulation of states. Mutual reciprocal feedback through face-to-face interaction elevates sympathetic arousal enabling increasingly heightened experiences of excitement in play and companionship. It expands the infant's intersubjective sense, mapping motor-sensory elements of the body-engaged-with-another. (Trevarthen & Aitken: 2001)

Body psychotherapists are equipped to engage in the regulation of body states through a whole variety of responses: playing non-verbally through movement, contact, making faces and voices; offering the physical warmth of a blanket, adjusting their physical proximity or actually holding the client; or just 'being there', showing interest, concern, delight, and supporting the client to self-regulate through rest or interaction.

The implications for body psychotherapy

The re-organisation of brain and body continues throughout life to be a complex response to developmentally specific (linear) and experience dependant (non-linear) processes. This outline of some of the major landmarks in very early development suggests how failures in early attachment impact basic emotional-physiological cycles and rhythms. In adult clients feelings may be inaccessible, log-jammed, or overwhelming.

Body psychotherapy is rich in interventions which actively and directly help the client experience, develop and transition between states on an autonomic spectrum. Another client used to stride around the room talking loudly and wanting to amplify every emotional event into a drama. In one session I had him lie down and put his hand on his chest to feel the vibration of his own voice. He spent a long time trying to connect the experience of feeling and listening to his own voice and then to take in my presence. He became aware of never having been listened to and therefore not knowing how to tune in to himself.

The attachment relationship, and later the therapeutic relationship, needs to attend to the nuance of feeling. Whilst a baby responds spontaneously to the human face, the older child and adult will often be embroiled in a more complex relationship to faces, negotiating self and other, inner and outer, past and present. In psychotherapy the therapist's eye contact may communicate understanding and acknowledgement of a range of ideas, acts and emotions. These may be explored by amplifying awareness of posture or movement, or by talking explicitly about what is being felt, or feared. When therapist and client have enough working history, it may be that a prolonged gaze is itself sufficient to re-organize awareness and deepen the sense of self-with-another.

Schore's tripartite model bridges the gap between theories which focus on reflexive responses, which are relatively primitive and unmediated expressions of instincts, and theories about the internalisation of an elaborate and complex social environment. Historically, body psychotherapy has been allied to the sub-cortex and the right brain. Working with impulse, breath, movement, sensation are all effective ways of enhancing the client's self-regulation quite directly. They enhance the body's motor sensory feedback loops which can lead to spontaneous re-balancing of nervous system and a more coherent sense of body-self. The strength of an approach to psychotherapy which engages directly with body states is that a basic level of self-regulation can be re-introduced even when defences against relational interaction are fairly entrenched. Panksepp suggests that 'all levels of information processing in the generation of emotional responses interact with each other' (1998: 33): Bodywork may be a 'way in' to a process that has been sealed off from awareness, buried in muscular armour and lack of connectivity within the brain. As Boadella has put it 'recovering motility awakens sensibility'. (Boadella 1997)

Auto and interactive regulation

Self-regulation is the ability to flexibly regulate emotional states through interactions with others (interactive regulation) and by oneself (autoregulation). (Schore 2003c: 25) In optimal circumstances this is an intrinsic capacity which develops from the dependency of early infancy to the complex varied interdependent self-regulation of a healthy adult.

The organisation of the brain-body is one of loops, spirals, and complementary structures. Reciprocal tension between the sympathetic and parasympathetic systems manages the metabolic and emotional energy for engaging and responding, and recovering equilibrium. As we have seen, the ANS is organised largely through the tripartite hierarchy of emotion-regulating sites, which feed into the right brain. On top of this, right and left cortices constantly negotiate or compete to optimize regulation. Vicissitudes in development are reflected in splits of all kinds (between components of experience, between parts of the self), and reflected in avoidance of interactive regulation, and/or an inability to manage difficult feelings without intense interactive regulation. (Carroll 2004) Much of therapy is about recognising and understanding existing regulatory patterns, supporting under-developed resources, and challenging and helping re-formulate defensive strategies.

In psychotherapy there is an opportunity for interactive regulation which enables greater emotional intensity and the re-organisation of brain-body. In an interactive regulation an unbearable state – of grief perhaps or shame – is felt with the support of the therapist's contained but active bodily resonance. It is a process of exchange, involving a high level of co-ordination and contact, occurring spontaneously through the holding quality of the therapist's face to face empathy. The client makes sounds, words and gestures to the therapist who receives them and accepts their full impact.

Bodywork can be a bridge to self-regulation, including more awareness of the self-in-relationship. It can also become a vehicle for collusion and enactment which bypasses interactive face-to-face regulation, inadvertently recapitulating the early attachment trauma. Auto-regulating strategies can be powerful unconscious and insidious mechanisms of control which have been essential to protect the client from painful feelings, but have become entrenched defences against the spontaneity and intensity of relating. This can take the form of avoiding anything to do with the body, or of a flight to the body to discharge intensity in sounds and movements which actually keep the client encapsulated in past experience.

Contemporary body psychotherapy is marked by a shift to a more relational emphasis, where explicit bodywork may be used sparingly and the body is more likely to be perceived in the context of the charged intersubjective field between client and therapist. (Asheri 2004, Soth 2003, Totton 1998) For this, the therapist needs both sensitivity to micro-changes or 'energetic' shifts in the client, and the capacity to speak to both the left (insight-oriented) and right (feeling-oriented) brain of the client. This is epitomised in the sophisticated use of the countertransference. The countertransference emerges from the therapist's very rapid processing of global and micro bodily information in themselves and the client. As these impressions take some kind of form – an impulse, a metaphor, a sensation, a feeling – they can be more fully processed, leading to new in-the-moment hypotheses. This intricate left-right client-therapist brain dance inspires 'the next move', be it spontaneously strategic or strategically spontaneous. (Carroll 2005)

[\[i\]](#) Neuroscience is now a major industry, linked with pharmaceutical business, genetic engineering and even the military. (Rees, D & S.Rose (2004) many therapists fear it may only be used in service of a medicalised, pragmatic, pharmacological model but the field of Affective Neuroscience, though small, is substantiating the emphasis on attachment and growth as a complex relational process. See Schore 2003 and Gerhard.

[\[ii\]](#) The word limit of the chapter means that information is very condensed. Broader detailed arguments are made in the manual that accompanies my lecture series Emotion and Embodiment.

[\[iii\]](#) Self-regulation of the autonomic nervous system is at the heart of body psychotherapy. Significant influences on me include biodynamic massage (Boyesen 1980, Carroll 2002c); charge therapy as taught at Chiron by Michael Soth; Bodymind Centering which I learned from Linda Hartley (Hartley 1994); and Somatic Trauma Therapy (Rothschild 2000, Levine 1997)

[\[iv\]](#) As well as autonomic characteristics, particular emotions are also differentiated by distinct neurochemical profiles. Molecular messengers called peptides are capable of evoking specific emotional tones and behaviours. Peptides include hormones, neurotransmitters, endorphins and growth factors. Well-known peptides associated with qualities of drive and feeling, are testosterone, oestrogen, progesterone and oxytocin - the 'bonding' hormone - and the stress hormones cortisol and adrenaline. Although Panksepp has begun to map the body and brain circuits of the major emotional operating systems, it is clear that the interaction of regulatory systems of hormonal, immune and metabolic function is very complex. (Panksepp 1998, Carroll 2004)