PERSPECTIVE

NEUROPSYCHOTHERAPY: DEFINING THE EMERGING PARADIGM OF NEUROBIOLOGICALLY INFORMED PSYCHOTHERAPY

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Abstract

Over the past two decades, the theoretical basis and application of psychotherapy has been undergoing a paradigm shift from a focus on higher cortical/cognitive processes to a new and growing appreciation of affective phenomena as the locus of behaviour change. The move has been prompted by breakthroughs in neuroscience that show bottom-up, left-hemisphere neural processes to underpin behaviour, validating affectively focused clinical practices. This paper examines the theoretical basis of this paradigm shift, with an emphasis on Klaus Grawe's consistency theory as central to its early description, and identifies the specific neural underpinnings for an effective clinical application of psychotherapy as established by contemporary neuroscience.

Keywords: neuropsychotherapy, definition, neurobiology, psychotherapy, neuroscience.

Introduction

The late Klaus Grawe (1943–2005) was a leading figure in the nascent field of neuropsychotherapy in the early 2000s (Dahlitz, 2013). His work integrated the latest neuroscience and clinical psychology, culminating in the publication of *Neuropsychotherapy*, a meta-framework of neurobiologically informed psychotherapy (Grawe, 2007). Not to be confused with a second tradition stemming from northern Europe, namely the psychotherapy of brain-injured patients by clinical and neuro-psychologists (Laaksonen & Ranta, 2013), Grawe's conceptualisation reflects a broad movement that has been described as a "mental health renaissance" (Rossouw, 2013)—an emerging paradigm empowering clinicians to use neurobiological findings to enhance therapeutic practice.

The practice of looking to neuroscience to establish empirical grounds for effective psychotherapy has been gaining momentum over the past decade under such labels as *brain-based therapy* (Arden & Linford, 2009), *interpersonal neurobiology* (Siegel, 2010), and *social neuroscience* (Cacioppo, Visser, & Pickett, 2006) among many others issuing from various individuals, groups and disciplines. The literature in English remains sparse, however, in relation to Grawe's original conceptualisation of neuropsychotherapy and its underpinning theoretical model. Contemporary theorists such as Pieter Rossouw (2014) are carrying the framework of neuropsychotherapy forward with refined ideas of Grawe's consistency theory (2007) and its clinical application.

Grawe grounded neuropsychotherapy in a model

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of mental functioning he termed the consistency-theoretical model (Grawe, 2007). Drawing on earlier models of basic psychological needs being serviced by psychological schemas (e.g., Epstein, 1990), he identified constructionist-like concepts of developing mental schemas and related them to neural networks that were identified in his extensive study of the neuroscientific literature of the time. Towards the end of his career he observed, "The empirical evidence suggests that we ought to conduct a very different form of psychotherapy than what is currently practiced" (Grawe, 2007, p. 417).

The current paper takes up Grawe's observation, reviewing the literature to determine in what ways the evidence suggests a "different form of psychotherapy". To this end the paper considers how this theory, grounded in neurobiology, informs and refines the clinical application of psychotherapy.

It is intended that this paper will fill a gap in the existing literature by disambiguating the term *neuropsychotherapy* and provide a concise reference for the neurobiological elements contributing to the meta-framework that is shaping psychotherapy today.

1. Neural Underpinnings

Freud began his *Project for a Scientific Psychology* (1895/1966) at the end of the 19th century with the intention of creating "a psychology which shall be a natural science" (p. 295), to discover the neural underpinnings of behaviour. Freud's psychoanalytic techniques were concerned with unconscious affective processes—a foreshadowing of the current neurobiological research into affect. In recent times Allan Schore, with a similar passion for uncovering foundational affective processes, has commented that "no theory of human functioning can be restricted to only a description of psychological processes; it must also be consonant with what we now know about biological structural brain development" (2013, p. 1). This resonates with Eric Kandel's (1998) landmark paper arguing that psychiatric thinking should be tethered to biological science due to the fact that therapeutic interactions can elicit structural changes in the brain. The following section will consider the physical structures, networks and processes that form the neural machinery of the brain, a machinery that both informs the theory of neuropsychotherapy and is modulated by the practice of neuropsychotherapy.

1.1 Neural Communication

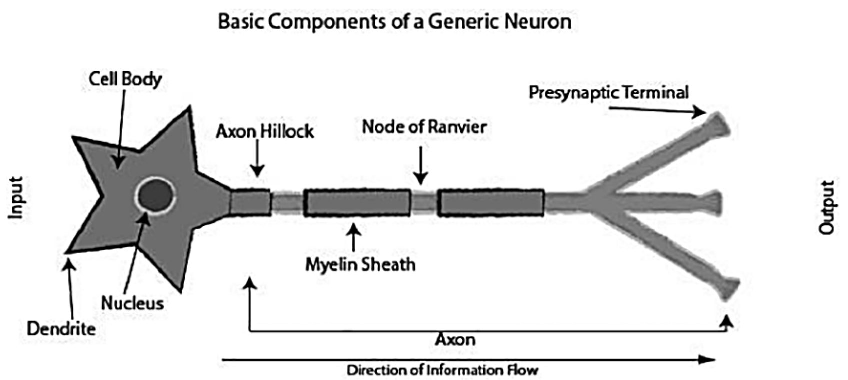
The human genome provides an organisational map for the development of our brains, with some designation of place and function of neurons fixed (by means of *coding* genes that constitute the so called "nature" part of our genetic make-up) and some functional aspects subject to the influence of experience (in the form of *no-coding* genes that make up the so-called "nurture" part of our genetic expression) (The Neuropsychotherapy Institute, 2014a). Our genome, along with epigenetic expression of genes and learning (memory formation) creates a complex neural communication system in our brain, which is itself a complexity of synaptic/dendridic connections modulated by neurochemicals. The basics of neural communication are described below.

Basic Nerve Cell Communication

In the nervous system there are two main divisions of cells: *nerve cells* (neurons), and *glial cells* (glia). Glial cells have traditionally been recognised as a "support network" for neurons, providing many essential functions for the facilitation of the neural network. However, they have more recently been acknowledged to form a communication network themselves, working in tandem with neurons (Keleman, 2012; Verkhratsky & Butt, 2007). The function of a neuron is determined by where it is in the brain, how it is connected with neighbouring cells, and its individual functional character. By analogy it is like us as human individuals: our function in society is determined by where we are, who we are connected to and how we interact with others and the environment (Cozolino, 2014).

While there are different types of nerve cells for different functions, it is helpful to consider a generic neuron—a model—that represents the fundamentals of all neurons. Figure 1 illustrates the main components of the neuron (see Kandel, Schwartz, Jessell, Siegelbaum, & Hudspeth, 2013, chapter 2, for a comprehensive description of neuron physiology):

Figure 1: Generic model of a neuron

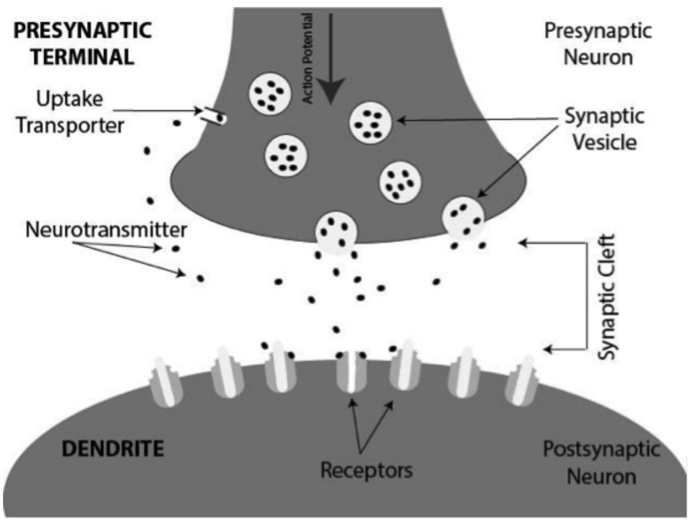


Neurons communicate using two processes: an electrical signal within the neuron, and chemical signals between neurons.

Neurons use various chemicals, known as *neurotransmitters*, to transmit signals across the very small gap between cells in an area known as the *synaptic cleft.* Most neurons can send and receive signals by different types of neurotransmitters, and different neurotransmitters work at different speeds (The Neuropsychotherapy Institute, 2014a).

The schematic in Figure 2 below is a radically simplified representation of a synapse. The upper part represents the *presynaptic terminal* of one cell's axon, and the lower part the *postsynaptic dendrite* of another cell. Communication flows from the presynaptic terminal to the dendrites of a neighbouring cell. Dendrites are like the branches of a tree that spread out to reach other cells, and are the main areas for receiving incoming signals (Kandel et al., 2013).

Figure 2: Simplified representation of a synapse



The *synaptic vesicles* shown above are packets of neurotransmitters that migrate to special release sites termed *active zones*. These packets come to the surface of the presynaptic terminal and are released (by a process known as *exocytosis*; Kandel et al., 2013) into the synaptic cleft. The chemicals diffuse across the gap, and some molecules are taken up by receptors on the opposite-facing dendrite. The receptor sites on the dendrite bind to specific neurotransmitters, and this binding will have either an inhibiting or excitatory effect on the receiving cell. This occurs via an opening of ion channels in the membrane of the cell that essentially produces a membrane potential in the dendrite (a positive or negative charge within the cell). The more positively charged a neuron becomes, the more likely it will pass a certain threshold and "fire". Ionotropic receptors, such as AMPA, accept transmitters that directly alter the receiving cell's potential, and are thus fast acting, whereas NMDA receptors require prior activation of the postsynaptic neuron through another channel before its ion channel can be opened (see Grawe, 2007, pp. 36–37).

Therefore some neurotransmitters will cause the receiving dendrite to become more positively charged, and others will cause the dendrite to become more negatively charged. The receiving dendrite "sums" the incoming chemical signals to arrive at a resultant synaptic potential which is then communicated to the main body of the cell. All of these "calculations" or synaptic potentials are summed at the beginning of the axon (the axon hillock). If the resulting charge rises above −55 mV (*depolarization*), an electrical signal flows from the axon hillock and down to the presynaptic terminals, causing the membrane of the each terminal to open up channels allowing calcium into the cell. This in turn causes the synaptic vesicles to release their chemicals into the synaptic cleft. This albeit simplified description of the process illustrates the binary nature of neurotransmitters in either initiating an action potential or not.

Figure 2 also shows some of the neurotransmitters being reabsorbed into the presynaptic terminal. Such uptake, via plasma membrane transporters, serves two purposes: recapturing the chemicals for reuse, and terminating the synaptic action of the cell (Kandel et al., 2013). Drugs used to inhibit the re-uptake of neurotransmitters will in effect keep the neurotransmitter in the vicinity of the postsynaptic dendrite, so that when receptors are available for that particular chemical, they will bind with it. Thus antidepressants are designed to inhibit serotonin re-uptake, keeping it in the synaptic cleft and prolonging post-synaptic activation (The Neuropsychotherapy Institute, 2014b). Another process whereby neurotransmitters are removed from the synaptic cleft is degradation, a process of chemical breakdown by enzymes where the resulting molecules are taken up by the presynaptic terminal. Within the presynaptic terminal the neurotransmitter is then reassembled for reuse, and repackaged for release once again. Finally glial cells also remove neurotransmitters from the synaptic space to prevent further interaction with the post-synaptic cell.

1.1.1 Neurochemicals

A basic understanding of the specific neurochemicals that modulate the nervous system is essential for understanding how certain pathologies are driven and why certain interventions are effective. The following is a brief introduction to these chemicals (The Neuropsychotherapy Institute, 2014b):

A) **Amino Acid Neurotransmitters** (the major neurotransmitters)

1) **Glutamates** are excitatory neurotransmitters. Receptor sites are either fast-acting ionotropic types (AMPA), which primarily activate or inhibit, or slower-acting N-methyl D-aspartate (NMDA) types, which facilitate a strengthening of the synaptic connection called long-term potentiation (Grawe, 2007, pp. 32–40). Glutamates bind with activating receptors, namely Alpha-amino-3-hydroxy-5-methylisoxazole-4-proprionic acid (AMPA), resulting in fast *activation* of the postsynaptic neuron (as described above).

2) **Gamma-aminobutyric acid** (GABA) is an inhibitory neurotransmitter. It is fast acting, binding with GABA receptors to cause an inhibiting effect on the postsynaptic cell. GABA and AMPA interactions are seen across the brain and result in much of the fast action of our neural processes—much of our thought processes and sensory input/processing, for example.

B) **Biogenic Amines** (monoamines, more localised in distribution than the amino acids and known to be released also from non-synaptic sites)

1) **Catecholamines** trigger physiological changes to prepare the body for physical activity such as the "fight-or-flight" response.

Dopamine has many functions, including motivation. Most dopaminergic neurons are in the midbrain and hypothalamus.

Norepinephrine acts as a hormone and a neurotransmitter. It increases heart rate and acts as a stress hormone affecting the amygdala.

2) **Indolamine** is the family of neurotransmitters that includes serotonin and melatonin (derived from serotonin).

5-HT (Serotonin) is involved in the regulation of mood, appetite, and sleep, as well as memory and learning. It is a major antidepressant.

C) **Acetylcholine** is used by only a few cell groups and is the major neurotransmitter in autonomic ganglia.

D) **Peptides** form a large and diverse group of transmitters. Some act as hormones, including enkephalines and endorphins.

E) **Others** including histamine and epinephrine, together with over 60 more that have been identified.

1.1.2 Activation Patterns and Neural Systems

A single neuron does not produce much information on its own through its binary function of either firing or not. Firing entails a certain rate, intensity and resulting neurotransmitter output at the synapse. A single neuron does not on its own "perceive" anything—perception is a group task in the world of neurons—but rather responds to specific input from other neurons, or directly from the environment in the case of sensory cells. To make sense out of the flow of information coming from our sensory organs, our neural system is organised into a hierarchy of increasingly complex networks. Individual neurons, boasting, on average, 10,000 connections to other neurons, together contribute to broader "neural net profiles" that represent an aspect of brain function (such as perceiving a particular sound), and these profiles integrate with many others to form various functions of our nervous system, some of which are concentrated in different areas of the brain (Siegel, 2012). Klaus Grawe (2007) describes as a hierarchical model of information processing, based primarily on the work of neurophysiologists David Hubel and Torsten Wiesel (1959, 1962, 1968), who demonstrated that neurons could have specific activation patterns in response to specific stimuli.

The hierarchy of our neural system is organised from sensory input to the perception of complex objects/understandings to even more complex cognitive and affective processes. For example, the "raw" visual data streamed from the sensory input of the retina is recognised by neurons in a fragmented fashion whereby individual parts of the scene are processed by neurons tuned to "recognise" small, specific elements. These fragments are then assembled by more complex neural networks involving higher-order cells that recognise the assembly of the parts. At the top of the hierarchy are cells and networks in the cortex that recognise the whole picture. Once this broader perception is realised, further cognitive/affective processes can occur as a result of this input. The flow of information is not serial but a complexity of parallel processing that utilises feedback from various brain regions. There is no neuron that can recognise the complexities of an object like a chair. Only the summation of complex networks, with experience (neural net profiles), can recognise a chair for what it is. Nor is there a single area of the brain that handles a specific mental function in isolation. Just as neurons do not perceive on their own, neural profiles activate and integrate with other regions across the nervous system (Siegel, 2012).

The brain is further organised into functional systems that to some extent can be identified by elements of the physical architecture of the central nervous system. From a single sensory input neuron, the scale of operations increases to complex hierarchies of neural networks that form maps representing input features in specific areas of the cortex. These complex signals are in turn processed within broad functional systems of organisation according to the physical architecture of the brain. Such functional architecture is currently being mapped by the Human Connectome Project (http://www.humanconnectomeproject.org).

A well-known division of the human brain is that described by neurologist Paul MacLean as the triune brain (MacLean, 1990). This evolutionary view of the brain describes three main regions in an evolutionary hierarchy: the primitive "reptilian" complex (the brainstem), the "palaeomammalian" complex (the limbic system), and the "neomammalian" complex (the cortex). The reptilian complex is fully developed at birth, while the palaeomammalian complex is partly developed and continues to develop during early childhood, and the neomammalian complex is mostly underdeveloped at birth and is the last part of the triune brain to develop (The Neuropsychotherapy Institute, 2014c). The implications of the model are that the survival instincts of the palaeomammalian complex (the limbic system) are significantly developed during the early years of life, distinct from the later-developing cognitive processes of the neomammalian complex (Rossouw, 2011). More sophisticated contemporary models of the brain and behaviour do not fully support MacLean's evolutionary model; however, the "bottom-up" perspective of development remains instructive for a corresponding bottom-up therapeutic approach (Rossouw, 2011). This bottom-up approach, as distinct from a top-down, cognitive approach, looks to establish safety through down-regulation of sympathetic over-arousal and activation of a state of parasympathetic security, resulting in increased cortical blood flow to the left frontal cortex for effective activation of cognitive abilities, and limiting "looping" activity within the limbic system (Rossouw, 2011, p. 4) to allow for effective new learning.

Iain McGilchrist, in his noteworthy book *The Master and His Emissary: The Divided Brain and the Making of the Western World* (2009), describes the asymmetry of the brain and the very different natures of the left and right hemispheres. This horizontal understanding of the mental system, as opposed to the vertical triune perspective, gives us insight into the distinctly different yet complimentary functions of the two hemispheres. In short, the right hemisphere handles broad attention (what we attend to comes first to us through the right hemisphere); is good at making connections so that we can appreciate the wholeness of dynamic structures and relationships that change over time; is attuned to emotion; and is empathic, intuitive, and moral. In contrast, the left hemisphere has narrow attention; is good at deconstructing things into parts; and has an appreciation for static, decontextualized, inanimate structures and abstractions. McGilchrist summarises the "two worlds" of the hemispheres in this way:

> The brain has to attend to the world in two completely different ways, and in so doing to bring two different worlds into being. In the one [that of the right hemisphere], we *experience*—the live, complex, embodied world of individual, always unique beings, forever in flux, a net of interdependencies, forming and reforming wholes, a world with which we are deeply connected. In the other [that of the left hemisphere] we "experience" our experience in a special way: a "re-presented" version of it, containing now static, separable, bounded, but essentially fragmented entities, grouped into classes, on which predictions can be based. This kind of attention isolates, fixes and makes each thing explicit by bringing it under the spotlight of attention. In doing so it renders things inert, mechanical, lifeless. But it also enables us for the first time to know, and consequently to learn and to make things. This gives us power. (McGilchrist, 2014, p. 31).

Allan Schore explains that the early-maturing right hemisphere is the locus of attachment formation and essentially the gateway to affect regulation later in life—so much so, indeed, that developing an expanded capacity for right-hemisphere processing (an emphasis on right-brained affective skills rather than a left–cognitive bias) is central to clinical expertise (Schore, 2012). In a similar vein Badneoch (2008) warns therapists to be grounded in right-brain engagement with clients or run the risk of being disengaged from the regulating and integrating influence of right brain-to-right brain connection with clients. She further encourages therapists to widen their window of tolerance (see section 1.1.6.1), be conscious of implicit vulnerabilities, and develop mindfulness to be present with both the client and self. There is a place for left-brain focus when thinking about specific interventions, but as McGilchrist admonishes, the left should remain servant to the master right hemisphere.

1.1.3 Memory Formation

The formation of implicit emotional memories lies at the heart of approach/avoidance motivational schemata (discussed in section 1.1.5) and constitutes a primary target for therapeutic change. It is therefore pertinent for the psychotherapist to understand something of how memory is formed on a neural level and what conditions might be necessary for change.

The hippocampus has been extensively studied and verified as a critical component of memory formation (Berger et al., 2012) but not the seat of memory storage. Various theories have been put forward as to how the hippocampus encodes memory and produces an output that is eventually stabilised as a long-term memory in other areas of the brain (Berger et al., 2012), likely across the cortex (Moss, 2013; Moss & Mahan, 2014). This structure is particularly sensitive to the stress response (increased cortisol levels), and in cases of severe violation or emotional abuse the hippocampus has been found to atrophy, inhibiting processes dependent on it such as synaptogenesis (Rossouw, 2012a). The critical role and sensitivities of the hippocampus become central to the formation of psychopathology, particularly in cases of early childhood abuse, neglect and trauma.

It has generally been agreed that memories are dynamic across time, in that new memories are in a labile state for a short time, when they are referred to as short-term memory (STM), after which they become "consolidated" into the physical structure of the brain to form long-term memory (LTM) (Nader, 2003). Of particular importance in the transformation of memory from STM to LTM is the transcription factor cAMP-response-element-binding protein (CREB) for memory stabilisation, including for emotional memories (Alberini, Milekic, & Tronel, 2006). Until recently it was believed that once a memory was stabilised into LTM, especially in the case of consolidated emotional learning, the neural circuits were fixed and the memory indelible (LeDoux, Romanski, & Xagoraris, 1989). This view has since given way to the understanding that memory is a dynamic process rather than a fixed state (Alberini, 2013).

The formation of emotional memory is of particular interest in psychotherapy, as it is the right-lateralised, non-verbal, implicit yet highly meaning-making memories of this type that shape foundational understandings of self and the world and determine how we anticipate the future.

1.1.4 Memory Reconsolidation

Memory research has demonstrated that memory is by nature a dynamic process to the extent that established memories can enter states of transient instability once reactivated and, from this state of instability, be modified before reconsolidation to a more stable state (Nader, 2013). An atypical isoform of protein kinase C called M zeta (PKMζ) is thought to be critical in sustaining LTM (Sacktor, 2008, 2010). Typically, persistent action of PKMζ maintains LTM via the continual regulation of GluR2-containing AMPAR receptors postsynaptically (Migues et al., 2010), and transient inactivation of PKMζ results in a loss of LTM (Nader, 2013). Of special interest for the practice of psychotherapy is that retrieval of a consolidated memory in juxtaposition with a *prediction error* or *mismatch* (see Ecker, 2015) can cause the memory to enter an unstable state, following which a restabilisation process, now referred to as reconsolidation, must take place for the memory to once again become stable (assuming continued PKMζ-AMPAR action) pending future recall into a liable state under the right circumstances (Alberini, 2011; Dudai, 2012; Lee, 2013; Nader, 2013; Nader, Hardt, Einarsson, & Finnie, 2013). It has been demonstrated that interrupting the reconsolidation process can impair the consolidating memory (Nader, 2012; see also Zhao, Li, Peng, Seese, & Wang, 2011, for an example of reconsolidation interruption using stress, and Ecker, 2015 for the necessity of a prediction error to be in juxtaposition with the retrieved memory to induce a liable state).

The implicit emotional memories (procedural memory) known to contribute strongly to motivational schemata are formed in the presence of strong emotion and stored in subcortical implicit memory circuits where they prove to be exceptionally durable (Roozendaal, McEwen, & Chattarji, 2009). However, when such memory is activated and enters a liable state—a temporarily deconsolidated state or "reconsolidation window" that is opened up via a "mismatch" condition and lasts from four to five hours (Ecker, Ticic, & Hulley, 2012; Pedreira, Perez-Cuesta, & Maldonado, 2002)—it can be radically unlearned. The opportunity to interrupt or modify memory in this way has obvious implications for psychotherapy, especially in regard to those memories that make up core motivational schemata. This "discovery of the brain's ability to delete a specific, unwanted emotional learning, including core, non-conscious beliefs and schemas, at the level of the physical, neural synapses that encode it in emotional memory" (Ecker et al., 2012, p. 13) can lead to the complete and permanent elimination of psychological symptoms.

1.1.5 Approach/Avoid Networks

The approach and avoidance motivational systems operate independently of one another and have independent neural substrates and mechanisms. They can be activated in a parallel fashion, although equally strong systems will tend to mutually inhibit each other.

Basic needs have a neural foundation from birth that initiates behaviour like crying, sucking, and wiggling the body to meet those needs (Panksepp & Biven, 2012). These genetically governed behaviours are the beginning of what will develop into much more personal and sophisticated motivational goals. The first need that develops into an "approach" goal is the need for proximity of the primary attachment figure. As the infant experiences encounters with her mother, she starts to develop a repertoire of behaviours to influence the mother to meet her needs. Neural activation patterns emerge that represent this and other goals, and are strengthened with the help of oxytocin and dopamine. Both baby and mother are rewarded by oxytocin and dopamine release when in loving, mutually satisfying connectedness. The increasing strength and complexity of these neural patterns continues to form circuits that become more easily activated, leading eventually to very sophisticated and spontaneously activated schemas. The specific groups of motivational schemas that develop to satisfy the basic needs of an individual are infinitely richer and more multifaceted than what might be suggested by the classification of just a few attachment styles. As the individual grows, motivational goals are shaped by his or her wider environment along with social expectations, limitations, and other cultural forces, shaping the neural architecture of personal motivational schemas.

On a physiological level, approach goals are associated with the left dorsolateral prefrontal cortex (PFC), while avoidance is more closely aligned with the right. For the processing of emotions, the left ventromedial PFC is associated with positive emotions and the right for negative emotions. These motivations and evaluations of approach/positive and avoidance/negative are in other words physiologically lateralised across the brain. There are more correlations to this same lateralisation in the deeper limbic system, giving credence to the theory that approach and avoidance are indeed neurally independent systems.

As they relate to pleasure maximisation (approach) and pain minimisation (avoidance), approach and avoidance schemas may seem to be opposites, like a positive and negative charge, but are just different goals with different modes of operation. The approach schema is about closing the gap between a desired goal and perceived reality to attain that goal which satisfies a need. There is often progress toward a goal, with rewards along the way, and then attainment or not of that goal. However, the avoidance schema is about increasing the distance between something undesirable and perceived reality, often to preserve or protect a basic need—a goal frequently not achieved, but nonetheless necessitating a state of continuous surveillance. When pursuing a positive goal, like completing a university course, it is relatively easy to determine whether one has come closer to the goal; there are subgoals and markers (such as completing a semester) along the way to the final destination of the goal. However, avoidance goals require constant control, as well as distributed, instead of focused, attention. For example, a husband may be anxious to avoid an argument with his wife; he has to keep vigilant, watch what he says, be careful to read the signs of a possible argument, and he can never reach the goal of avoidance because there is always the possibility that conflict may come in the future. This sort of avoidance is more a matter of continuous attention, and often anxious tension, than simply apprehending a concrete goal. Individuals with strongly formed avoidance goals (or with a dominance of avoidance over approach goals) experience fewer positive emotions and less satisfaction of need because of the disproportionate amount of energy and focus invested in avoidance. In fact, strongly developed avoidance tendencies, both implicit and explicit, have many unfavourable effects on mental health, self-esteem and general well being (Grawe, 2007)

From a neuropsychotherapeutic perspective, therefore, therapy should aim to reduce the use of avoidance goals and promote more positive approach goals to satisfy basic needs. The behaviour of depressed clients can frequently be attributed to a hyperactivation of avoidance schemas, inhibiting approach schemas and inviting the negative impact of stress hormones that damage the hippocampus and deactivate the anterior cingulate cortex. A therapy that can weaken the established avoidance tendencies and gradually reactivate the approach system will revitalise activity in the anterior cingulate cortex and strengthen PFC connections—concrete developments that will likely result in a positive change for the client.

Neural Mechanisms of Approach and Avoidance Learning

In a typical neural learning scenario the hypothalamus informs the PFC of physiological states (e.g., the system has a low blood sugar level), and the decisions made in the PFC (e.g., getting something to eat) are transmitted to the nucleus accumbens, which in turn triggers a process eliciting and strengthening behaviour (behaviour reinforcement mediated by dopamine). The nucleus accumbens integrates information coming from the amygdala (representing emotion), and hippocampus (location/context), and makes a decision to activate or terminate a behaviour. If the nucleus accumbens has given the "go" signal to get something to eat, then the act of eating and satisfying hunger releases dopamine, and the dopamine binds with receptors involved with motor actions and perceptions of eating. Through second-messenger cascades an elevated synaptic transmissions ensues, and the whole network that has been activated is strengthened, making it easier for the same network to activate in the future. Dopamine is the reinforcing agent in this scenario and represents neural motivation, or motivational salience in establishing behaviour. Any behaviour that is reinforced involves the release of dopamine. Because dopamine is essential for motivation and learning (establishing and reinforcing synaptic connections), in therapy, learning must have high motivational salience to be effective. In real terms, without the activation of the dopamine system, substantial positive long-term learning will not take place. Dopamine is the intrinsic motivator and energiser of approach/avoidance schemas and is therefore of central importance to the therapeutic process.

1.1.6 The Social Brain

Human beings are social creatures. We collectively form families, communities and cultures that define us as much as we define those systems. Relationships nurture us and shape us into who we are. In this section I consider what Cozolino (2014) has termed the "social brain": those neural systems that form and perform within the scope of interpersonal relationships.

The social brain revolves around what Siegel calls the middle prefrontal region that includes the insula, orbitofrontal cortex, ventromedial prefrontal cortex, and the anterior cingulate cortex (Siegel, 2012). This region is the interface between other integrating, planning and thoughtful parts of the cortex and the limbic system (Siegel, 2012). The middle prefrontal region, in conjunction with ventral vagal activation (see discussion below), constitutes the neurophysiology of the social system that mediates attuned communication, flexible responsiveness, affect regulation, empathy, insight, morality, and intuition (Badenoch, 2008). When the limbic system is not strongly integrated with the middle prefrontal region, limbic-biased swings of emotion, fuelled by established implicit emotional memories to external cues, can result in self-reinforcing loops of affective responsiveness. Hypothalamic-pituitary responses match the emotional tone of the initial response, producing changes in the body that reinforce and intensify the emotional response (Badenoch, 2008). On the other hand, a strong middle prefrontal cortical influence over amygdala reactions (mediated by a strong GABA response) can effectively modulate an otherwise emotionally over-reactive response.

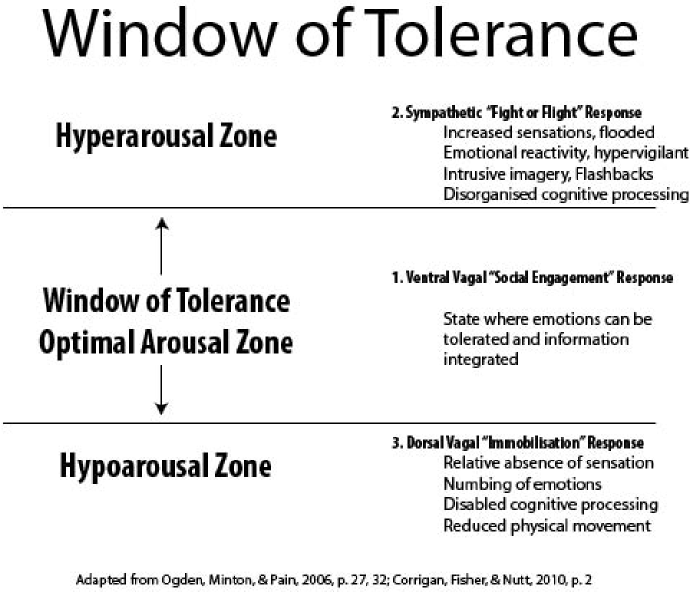
The most primitive functions of the social brain are grounded in the affectively and somatically biased right hemisphere, where subcortical "bottom-up" processing of emotional and social information dominates (Cozolino, 2014). Navigating the social world effectively requires good integration between left and right hemispheres as well as between cortical and subcortical systems. This important concept of neural integration will be explored in section 4.

1.1.6.1 Window of Tolerance and the Ventral/Dorsal Vagus

The "window of tolerance" (Siegel, 1999) describes a model of autonomic arousal levels in which an optimal arousal zone, or window of tolerance, operates between hyper- and hypoarousal of the autonomic nervous system (Ogden, Minton, & Pain, 2006). This model can also be conceptualised according to the polyvagal theory of Porges (2011), which views the autonomic nervous system as organised into three levels of activation: the ventral vagus/parasympathetic branch, the sympathetic branch, and the dorsal vagus/parasympathetic branch (Ogden et al., 2006). Of the three, the ventral vagus is known as the "social engagement system" (Porges, 2011; see Figure 3).

Maintaining arousal within the window of tolerance ensures integration of top-down and bottom-up processing while keeping the social engagement system "online" (Ogden et al., 2006). When the window of tolerance is narrow, as can often be the case with

Figure 3: Window of tolerance



those who have experienced trauma, there can be a tendency to move into a hypo- or hyperaroused state in reaction to stimuli that activate implicit traumatic memories. In such states there is reflexive defensive reacting, rather than prefrontally mediated integrative and flexible responding to the stimuli (Siegel, 1999). Rapid oscillations between hyper- and hypoarousal can take place in a desperate attempt to achieve regulation—a situation that has been likened to a "biphasic rollercoaster" (Corrigan, Fisher, & Nutt, 2010).

From a neuropsychotherapy perspective, the importance of widening a client's window of tolerance, especially in the case of trauma, becomes a central goal. Achieving this will increase a capacity to tolerate and integrate thoughts and feelings and keep the ventral vagal social engagement system operative.

2 Consistency

Consistency is the overarching concept of *systemic agreement* that can be considered a "core principle of mental functioning" (Grawe, 2007, p.168). The myriad simultaneously occurring processes in the nervous system function optimally only to the extent that the various elements of the system remain in harmony and are not conflicted. This is a foundational principle of neuropsychotherapy.

The now famous Stroop test (Stroop, 1935) is a classic example of activating conflicting mental processes and thus compromising performance speed as the anterior cingulate cortex and the dorsolateral prefontal cortex (Milham, 2003) work through inconsistent patterns to arrive at a resolution. On a more complex level, an individual's experience of the world, internal model of the world, and meeting of needs can be in conflict—a state of internal inconsistency from which dissatisfaction and stress arise. It is with an induced state of *controlled incongruence* within a system striving for consistency, that we can effect neural, and therefore therapeutic, change.

2.1 Consistency Theory Model

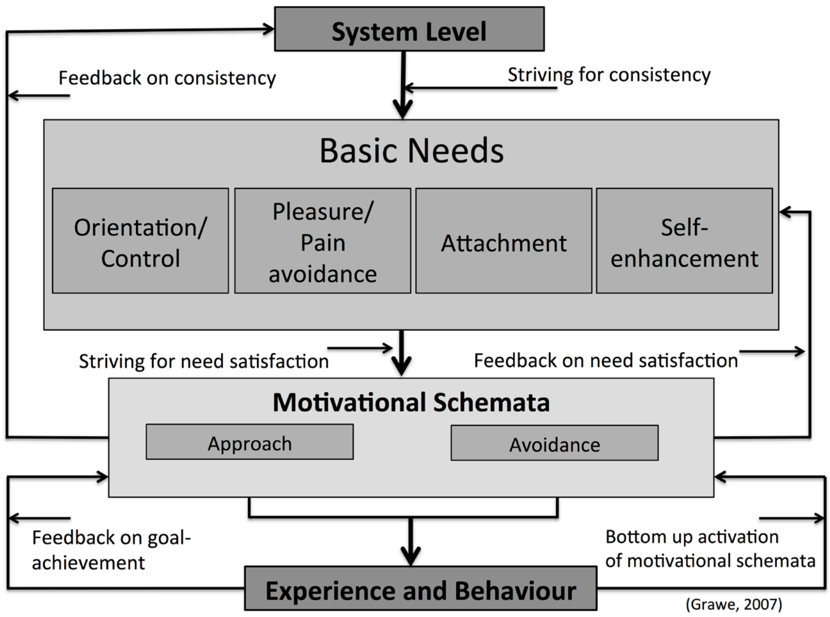
The consistency theory (Grawe, 2004, 2007) view of mental functioning is derived both from broadly accepted findings that goals and schemas govern mental activity and from Grawe's own argument that goal formation is developed to satisfy four basic psychological needs: attachment, orientation & control, avoidance of pain/maximisation of pleasure, and self-esteem enhancement. The core constructs of consistency and congruence are the keys to understanding the development and maintenance of both normal and pathological mental processes.

Consistency is described as the "compatibility of many simultaneously transpiring mental processes" (Grawe, 2007, p.170), and is a systemic demand, on a neural level, for harmonious neural flow. When the relationship between intrapsychic processes and states is harmonious, there exists a state of consistency. The human nervous system strives to avoid inconsistency and develops various mechanisms to move from a dissonant, inconsistent state to a more harmonious state. Consistency regulation is predominantly unconscious and only rises to conscious awareness under exceptional circumstances. The mechanisms an individual uses to avoid or correct significant inconsistencies have been termed defence mechanisms, coping strategies, or affect regulation.

Congruence, a construct that is expressed under the umbrella of consistency, is the harmony or compatibility between motivational goals and current perceptions of reality. According to Powers (1973), *incongruence* signals are generated from the feedback mechanism that contrasts our perceptions with our goals. Grawe argues that "an elevated incongruence level can be regarded . . . as a highly complex stress state" (Grawe, 2007, p. 172).

A motivational schema is a neural network developed to satisfy and protect basic needs. There are many such schemas, but they may be broadly divided into two classes: *approach* schemata and *avoidance* schemata (see figure 4). Approach and avoidance schemata operate on different neural pathways (Grawe, 2007). If an individual grows up in an environment where needs have been met, especially during the critical early attachment phase, then approach schemas of interacting with the environment are likely to develop, resulting in approach-oriented behaviour. Conversely, an individual whose needs are continually threatened and violated is likely to develop avoidance schemas that will motivate insecure, anxious, and avoidant behaviour. Attachment theory (Bowlby, 1988, 2008) furnishes a critical understanding of the foundation of mental schemata, explaining how securely attached children develop primarily approach motivational schemas and insecurely attached children develop avoidance motivational schemas.

Figure 4: Consistency-Theoretical Model (Grawe, 2007, p. 171)



According to consistency theory, there are three ways the mental system can experience inconsistency: through *approach incongruence*, *avoidance incongruence* and *discordance*. These upset the neural harmony of the system, creating a system demand to reduce such stress or dissonance.

Approach Incongruence: If an individual has a tendency to use avoidance motivational schemas—that is, if there is an established neural propensity to avoid perceived threats to basic needs rather than seek to satisfy those needs— he or she can experience incongruent signals due to unfulfilled approach schemas. To illustrate, consider a young woman who has a desire to meet a man, but fear of rejection prevents her from placing herself in situations where she may meet a potential partner. The avoidant motivational schema is well established to protect her from the pain of rejection by another human being, and prioritises the maintenance of whatever self-esteem and control over circumstances she has. However, there is at the same time a desire represented in another motivational schema to approach, to apprehend, to secure a loving relationship with a partner and satisfy the need for attachment. It is when this latter desire is suppressed or overridden by the stronger avoidance schema that the individual experiences approach incongruence.

Avoidance Incongruence: When attempts at avoidance ultimately fail, and what was feared actually happens, the individual experiences avoidance incongruence. To continue the previous illustration, if the young woman does go to a local dance to meet a potential partner and is, after all, rejected, she will experience avoidance incongruence—the very undesired consequences her avoidance schema had motivated her to protect herself from.

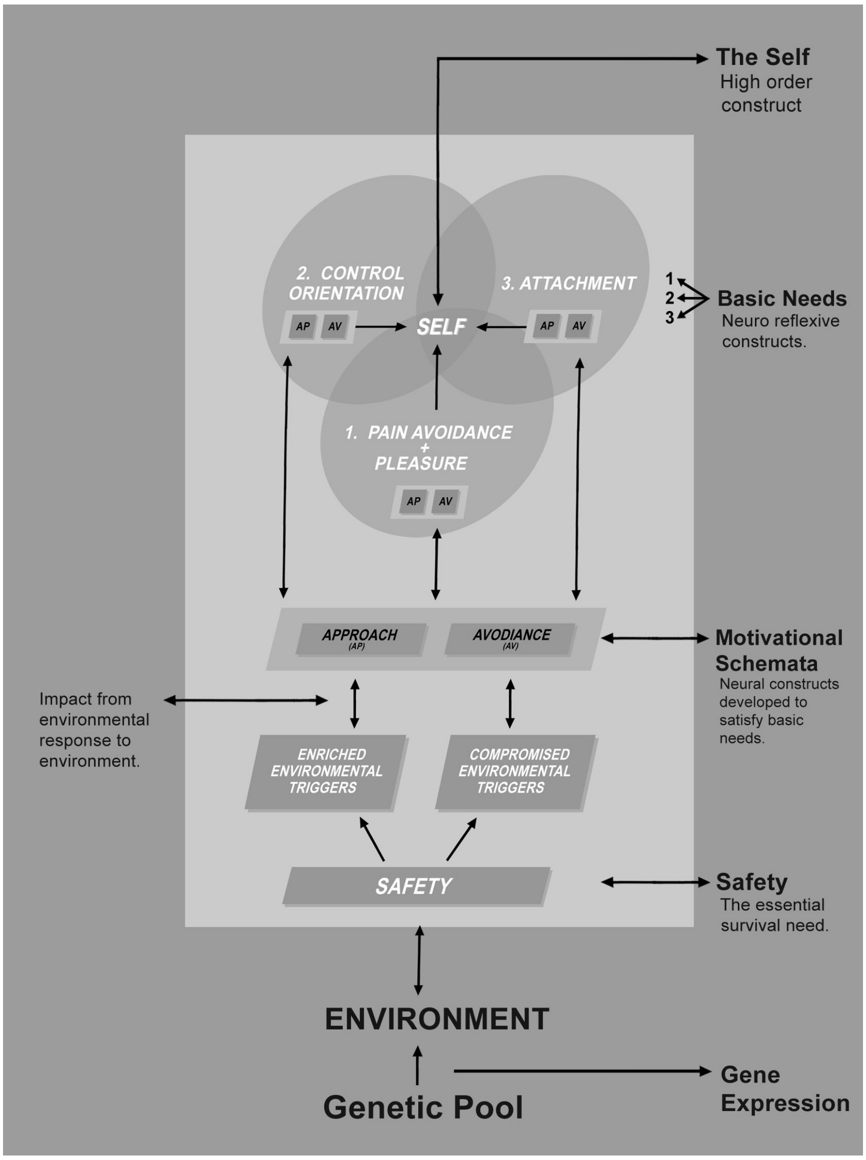
Discordance: Discordance occurs when two or more motivational schemas are activated simultaneously and are incompatible with one another. This is not an incongruence between perception and goal but rather two incompatible goals being activated simultaneously.

Incongruence and discordance, and the affect that accompanies them, can occur implicitly or explicitly and create *inconsistency* in the system. Continual inconsistency can impair an individual's effective engagement with the environment and lead to increasingly avoidant tendencies, stress, negative emotions, anxiety, and a range of serious mental difficulties, as limbic survival mechanisms dominate to protect the individual who is descending into a highly complex state of stress.

The consistency model conceptualises behaviour as an attempt to *attain* or *protect* the object of basic needs through motivational schemas that have been shaped by earlier experiences (of attachment in particular), in a way that provides agreement with our perception of the world and our internal model of the world and ourselves.

There are current attempts to refine Grawe's model so that the basic psychological needs are portrayed in a less linear fashion and are seen as overlapping in their neural arrangement, with the superimposition of the basic needs yielding a higher-order construct of "self". Figure 5 shows a particular refinement by Rossouw (2014) where the higher-order construct of "self" emerges from the neural milieu of needs and motivational schemata.

Figure 5:
Integrated Model of the Base Elements of the Theory of Neuropsychotherapy (Rossouw, 2014, p. 57)



2.2 Motivational Schemas

A motivational schema is a construct, or more concretely a neural network, developed to satisfy and protect basic needs. Such a schema can generally be classified in terms of either approach or avoidance tendencies. Approach and avoidance motivation has a long history; the concept first appeared in the writings of Greek philosopher Democritus of Abdera (460–370 B.C.E.), broadly seeking to explain behaviour as directed either toward positive stimuli (approach) or away from negative stimuli (avoidance) (Elliot, 2008). In the full spectrum of approach–avoidance motivation there are orientating exteroceptive reflexes such as the startle response, salivary reflex, and pain withdrawal, but for the purposes of neuropsychotherapy such schemata are psychological orientations toward or away from stimuli (concrete objects/events/possibilities, or abstract subjective representations) that may or may not have a corresponding somatic movement or action. Furthermore, "movement toward" can represent either gaining something positive that is currently absent or keeping something positive that is currently present (in functional terms, continuing toward). Likewise, "movement away" can represent either keeping away from something negative that is currently absent (functionally, continuing away from) or getting away from something negative that is currently present (Elliot, 2008, p. 8).

The consistency theory model conceptualises all behaviour as the product of approach and avoidance motivations. The somewhat binary nature of this view may seem oversimplistic at first glance, but its complexity lies in the fact that many approach and avoidance schemata can be operating in parallel (as in the case of *motivational discordance*, Grawe, 2007, p. 171) and in a hierarchical manner (Elliot, 2006) to service not only our basic psychological needs, but also physiological reflexes, as we navigate our experiences of the world.

Hemispheric differences exist in regard to approach/avoidance motivations whereby the left hemisphere is biased toward approach (positive) emotions and the right biased toward avoidance (negative) emotions (Canli, Desmond, Zhao, Glover & Gabrieli, 1998; Davidson 1992; Paradiso et al., 1999).

In the neuropsychotherapy conceptualisation of the mechanisms of change, it is the motivational schemata that are the cause of distress and, consequently, the target for change. They are developed through right-lateralised implicit emotional learning during attachment, represented by neural networks, and changed in a therapeutic setting by intersubjective right brain-to-right brain regulation that uses controlled incongruence to shift neural and memory reconsolidation, thereby transforming existing neural networks.

2.3 The Science of Affect

Of primary significance to the theoretical underpinnings of neuropsychotherapy is the paradigm shift in psychotherapy from explicit, left-brained, conscious, cognitive processes to implicit, right-brained, unconscious, affective–relational processes (Schore, 2014). For over two decades Allan Schore has been at the leading edge of neurobiological research on emotional and social process, in particular how neurobiologically informed attachment theory is essentially right-brained, implicit, and affective in nature (see Schore, 2012, for a comprehensive review of this work). The development of a right-lateralised "social brain" represents the most important substrate of human unconsciousness, which is fundamentally affective in nature and the most salient focal point for therapeutically mediated change (Cozolino, 2014; Schore, 2014).

According to modern attachment theory (Schore & Schore, 2008), the development of the self occurs in the context of attachment relationships with another brain and involves affect regulation through "episodes of right-lateralized visual-facial, auditory-prosodic, and tactile-gestural nonverbal communications" between infant and primary care giver (Schore, 2014, p. 389). This regulating developmental mechanism, which is primarily an implicit right brain-to-right brain process, is central to all later aspects of development and to social-emotional functions (Schore, 1994, 2003a, b, 2012, 2014) and consequently of primary importance in the therapeutic setting. This is due to the fact that such right-lateral implicit memories form an internal working model that becomes the "nonconscious strategies of affect regulation" (Schore, 2014, p. 389)—the construct Grawe conceptualised as approach/avoidance motivational schemata (Grawe, 2007). These schemata, through early social-emotional experiences, can be developed in a neurologically disadvantaged manner (Watt, 2003) whereby dysregulating, insecure attachment experiences create right cortical-subcortical networks (Schore, 2014) that are primarily negative (avoidance) affective states and endure into adulthood (Grawe, 2007).

In adults the right lateralized prefrontal system represents the highest order of affect regulation, specifically activated in the therapeutic alliance, and plays an important role in psychotherapeutic change via implicit communication between therapist and client (Schore & Schore, 2008; Stern et al., 1998). This process, described as "intersubjectivity" (Schore & Schore, 2008), highlights the importance of nonconscious, nonverbal right-brain communication in the two-way process of change (a point expanded on in section 3.2), where the right prefrontal cortex plays a vital part in relating self with the world amid disturbances in such two-way personal relatedness (Feingberg & Keenan, 2005). Given that clients in therapy are likely to have motivational schemata of avoidance, and that the therapeutic alliance directly connects the therapist and client in a right brain-to-right brain affect-regulating process, the intersubjective mechanism of change is a core focus of neuropsychotherapy.

3. Basic Psychological Needs

Klaus Grawe developed a view of mental functioning that combined insights from mainstream contemporary psychology with an understanding that "the goals a person forms during his or her life ultimately serve the satisfaction of distinct basic needs" (Grawe, 2007, p. 169). Influenced by Seymour Epstein's cognitive-experiential self-theory (Epstein, 1973, 1980, 1991 1993, 1994, 1998; Teglasi & Epstein, 1998), Grawe defined four key psychological needs that provide the motivation for behaviour: the need for attachment, the need for control/orientation, the need for pleasure/avoidance of pain, and the need for self-enhancement (Grawe, 2007; see also Epstein, 1994, p. 715 for the origins of these four needs). As outlined above, implicit motivational schemas are designed to satisfy these four psychological needs via approach-driven (primarily cortical processes) or avoidance-driven (primarily limbic processes) behaviour in what Epstein describes as an emotionally driven experiential system (Epstein, 1994).

3.1 Attachment

John Bowlby (1973, 1988) clearly demonstrated that the basic need for an infant is the physical proximity of a primary attachment figure, bringing the importance of attachment into mainstream psychology. Bowlby (1973) described the basis of this attachment theory into three central postulates that could be summarised like this: a) A child with an available, trusted caregiver will be less anxious than one without such a caregiver; b) trust or lack of trust in the availability of the caregiver will translate into a similar expectancy of relationships later in life; and c) the expectations a child has of a caregiver are relatively true of the actual experiences of the caregiver.

Bowlby referred to this theory of attachment as the internal working model, a concept taken from Kenneth Craik, who proposed an organism carries a "small-scale model" of external reality in its head (Wallin, 2007, pp. 26–27). In essence, early dyadic relationships, especially with primary caregivers, form implicit memories from which a child constructs schemas, or ways of understanding and interacting with the world. The way parents approach their infants shapes the very structure of their developing brains (Schore, 2012) through a resonant system of proximity and gaze. As Bonnie Badenoch puts it, "What is alight in the parental brain lights up in the newborn brain. It is as though the parent is passing on the family's emotional legacy in regards to relationships through these initial firings and wirings" (Badenoch, 2008, p. 53).

Mary Ainsworth, a colleague of Bowlby, developed an empirical method for assessing attachment in infants called the Strange Situation Protocol, based on Bowlby's attachment theory (Ainsworth, Blehar, Waters, & Wall, 1978). Ainsworth observed the behaviour patterns of young children when they were separated and then reunited with their mothers in a controlled environment. Several attachment styles were identified to this point: secure attachment, insecure-avoidant attachment, and insecure-ambivalent attachment (Ainsworth et al., 1978; Badenoch, 2008; Grawe, 2007). Later, Mary Main and colleagues (Main & Solomon, 1986) identified another style they called insecure-disorganised/disorientated attachment.

The children who were found to thrive in life were those children with secure attachment patterns rather than those with insecure patterns. Attachment patterns start to form in the first months of life—a time when brain development is extremely rapid, the sympathetic nervous system is dominant, and right-hemisphere limbic learning is critical (Badenoch, 2008)—and lay a foundation for motivational schemas that ultimately drive behaviour.

3.2 Orientation and Control

According to Epstein (1990), the need for orientation and control is the most fundamental of all human needs. In accordance with Powers' (1973) perceptual control theory, this need plays out in a pervasive striving for perceptions of reality that are consistent with the individual's goals, and this striving is a major driver of behaviour and mental life. To attain such a goal requires control over our environment, or at least our perception of the environment. Grawe (2007) further explains that control, in this context, is not just about manipulating or regulating the environment or relationships to achieve goals, but also to have a maximum number of options available to us that we are free to act upon. How we choose to take up the options available to us will be determined by our motivational schemas.

A sense of control begins with the infant, in the context of attachment, having the volition to manipulate the environment to meet his or her needs. For example, an infant crying when hungry has the desired outcome of bringing Mother who then feeds the child. If the child cries for food and no food comes, there is an incongruence (the gap between what the child needs and what she perceives she has) within the child, and with such a violation of the need for attachment there is a corresponding violation of the need for control. A satisfaction of the need for control, on the other hand, causes a reduction in distress, which in turn strengthens the sense of control.

There is a component, or an understanding, of control that can be described as the need for *orientation*, that is, to be able to have an accurate appraisal of a situation, and to understand what is going on. To gain such clarity about one's situation, and what can be done to improve it, is an important aspect of control. It is a common experience in psychotherapy to see a better sense of control gained simply from understanding a situation with greater clarity. In view of this need for orientation, effective (disorder-specific and problem-specific) therapeutic interventions are always accompanied by a more optimal satisfaction of the need for control.

3.3 Pleasure Maximisation and Pain Minimisation

Freud, in his theory of personality, postulated a single fundamental need that he characterised as the pleasure principle: the need to maximise pleasure and minimise pain (Freud 1920/1959). Epstein considered this a core need (1994), as did Grawe (2007).

The basic premise of this need is that we are motivated to attain pleasant experiences or states and avoid unpleasant or painful ones. These states may be physical, psychological, emotional, or social. Neurologically there is an automatic implicit evaluation of experience as either "good" or "bad", to the degree that there is a continual monitoring of our experiences (one aspect of this process is known as *feedback-related negativity*, see Hajcak, Moser, Holroyd, & Simons, 2006; Nieuwenhuis, Slagter, Von Geusau, Heslenfeld, & Holroyd, 2005). Humans have a motivation to maximise experiences of the good and limit the bad, even in the case of suffering "for the greater good"—the denial of some pleasures to attain something of greater worth further down the track. What constitutes "good", pleasurable, beautiful, and the like is dependent upon the individual and how his or her experience of things is consistent with the satisfaction of the other basic needs. Grawe contends that the individual is in a maximal state when his or her "current perceptions and goals are completely congruent with one another, and the transpiring mental activity is not disturbed by any competing intentions" (2007, p. 244). This maximal state, a state of pleasure, is comparable to Mihaly Csikszentmihalyi's concept of "flow" (1991) that describes our intrinsic motivation to align our perception of experience with our intentions.

Just how a person will size up the world around him is dependent on both his prior experience and his momentary state. For example a hot drink on a very hot day may be evaluated more negatively than an ice-cold drink, and vice versa on a cold day; this is a state-dependent evaluation. By contrast, the experience of going on a roller-coaster is likely to be far less state-dependent—to one individual it may be evaluated as bad and to another as good, according to each individual's prior experiences with roller-coasters. The relearning of taste preferences is a complex process influenced by motives such as social compliance and positive self-evaluations, yet the same automatic evaluative process is in play. The development of a taste for wine, for example, may be motivated by a need for social acceptance (attachment and self-esteem), but ultimately becomes an automatic preference for wine as part of the neural evaluative process.

When a situation is evaluated either positively or negatively, it triggers an approach or avoidance tendency, meaning that our mental activity is primed in a certain direction. For example, someone who evaluates New York cab drivers as bad on the basis of past negative experiences may be primed to "jump" at the sudden lane changes made by the driver. Another person with a more positive evaluation of New York cab drivers may not be startled or fearful at all at the same sudden lane changes. This motivational priming is the orientation of the motivational system to be either more approach or more avoidant toward certain cues in our environment.

Mental processes transpire more easily and quickly when the good/bad evaluation is compatible or synchronised with the behavioural approach–avoidance orientation. When evaluations and behavioural orientations are consistent, the mental system works more efficiently and with less stress.

3.4 Self-Esteem Enhancement

The need for self-enhancement or self-esteem has been regarded as a fundamental function of our humanity and has been called the "master sentiment" (McDougall, 1936, p. 224) and "the basic law of human life" (Becker, 1971, p. 66), as the only one of the four needs that is distinctly human. Self-esteem has been defined as "an individual's subjective evaluation of her or his worth as a person. If a person believes that she is a person of worth and value, then she has high self-esteem, regardless of whether her self-evaluation is validated by others or corroborated by external criteria" (Trzesniewski, Bonnellan, & Robins, 2013, p. 60). There has, however, been debate as to the importance of this construct, with some arguing that self-esteem is essential (Orth, Robins, & Widaman, 2012) and others considering it of limited value in that it is likely a reflection of other processes (Boden, Fergusson, & Horwood, 2008, Zeigler-Hill, 2013). The self-esteem that Grawe conceptualised as a basic need is a global one that is secure and congruent as opposed to unstable, narcissistic, or discrepant (see Park & Crocker, 2013). It is possible, however, that self-esteem is a complex construction emerging from more fundamental needs, closer to an outcome of self-perception than a universal basic need, indeed a perception that may be a culturally driven construct that does not qualify as a "basic" need (Dahlitz & Rossouw, 2014).

In some cases, to preserve the greatest number of needs, one need may be "sacrificed" for the benefit of the others. For example, the maintenance of low self-esteem may be an avoidance pattern utilised to fulfil another need such as preventing pain or preventing loss of control, or to protect existing self-esteem from further degradation. An activated avoidance schema may be sacrificing high self-esteem to attain another need, such as attachment through acceptance, and being accepted, in a roundabout way, serves to satisfy some aspect of self-esteem. So the tendency to self-esteem enhancement can be regarded as part of the approach system, and self-esteem protection can be regarded as part of the avoidance system. The exact reasons for an individual maintaining low self-esteem may be complex, but in context with other needs, this may very well be a compromise strategy to achieve overall need fulfilment/protection as best the individual can.

Those who do satisfy the need for enhanced self-esteem are characterized by better mental health. These people will take opportunities to enhance their self-esteem through approach motivational schemas. Individuals with a healthy self-esteem will evaluate themselves more positively than objective observers. It has also been observed that having unrealistic perceptions of self satisfies the self-esteem enhancement need, and is a good indicator of overall mental health.

Mentally healthy individuals also have a skewed perception of reality with regard to themselves, often seeing themselves as "above average" within the general population. People with high self-esteem will also take advantage of opportunities to further enhance their self-esteem. Because those who have a healthy sense of self regard themselves better than average in a multitude of areas, striving for an absolutely realistic self-evaluation may not be in their best interests for mental wellbeing. Deluding oneself in the meeting of basic needs can lead to positive feelings and in turn to attaining a better state, a bit like a self-fulfilling prophecy. Depressed individuals, however, who have a more pessimistic view of reality, do not share this delusion and are prone to further mental problems. Operating out of avoidance schemas, these individuals experience life, and take on roles, in a way often detrimental to self-esteem.

The meta-framework of neuropsychotherapy is necessarily a multidisciplinary perspective that requires the psychotherapist to have a broad understanding of the elements discussed here, from basic neural communication and networks to psychological needs and how we go about enhancing and protecting them. The following section goes on to describe the clinical implications and applications of this knowledge.

4. Clinical Application of Neuropsychotherapy

A focus on the neural underpinnings of behaviour provides an opportunity in therapy for neurobiological empathy between client and therapist, reducing any stigma or self-blame that may have come from a pathologising perspective, and allowing for better conceptualisations of psychotherapeutic techniques and theory (Grawe, 2007). The clinical application of neuropsychotherapy focuses on strengthening clients' resources from the core of their motivational system to facilitate an increasingly robust approach to self and the world (Flückiger, Wüsten, Zinbarg, & Wampold, 2009). Such approach motivation ultimately leads to better need satisfaction and subsequent mental well-being.

Pragmatically, this entails establishing a "safe" therapeutic alliance to facilitate approach patterns that will satisfy basic needs, down-regulate stress activation, and optimise new, positive neural connections while reinforcing existing ones (Rossouw, 2014).

4.1 Controllable Incongruence as the Lever for Change

From a clinical perspective it is controllable incongruence that becomes the mechanism of change within the therapeutic dyad. As stated above, incongruence is the discrepancy between an individual's perception of reality (his or her actual experience) and beliefs, expectations, and goals (Grawe, 2007). Such incongruence will cause inconsistency within the mental system. *Controllable incongruence* is a situation of incongruence that one believes is within their capacity to cope with—it may be a challenge, but not an overwhelming one. *Uncontrollable incongruence*, on the other hand, is a circumstance that exceeds one's ability to cope, or belief that one can cope, with the mismatch between what is experienced and one's goals.

Uncontrollable incongruence, then, is a stressful state that heightens arousal potentially beyond one's window of tolerance and, if not resolved, can result in a hyperactivated HPA-axis cascade, releasing damaging amounts of glucocorticoids into the system. In a regulated stress response, a feedback loop will down-regulate the HPA-axis activation and attenuate the release of stress hormones (Kandel, Schwartz, Jessell, Siegelbaum, & Hudspeth, 2013). In a state of continued stress—as with unresolved uncontrollable incongruence—this feedback mechanism is overridden and a continued flow of glucocorticoids can inhibit the formation of new synapses (new learning) while degenerating existing glutamate synapses, especially in the hippocampus, destabilising previously formed neural connections (established learning) and even inducing complex negative structural changes in various brain regions (Lupien, McEwen, Gunnar, & Heim, 2009; Popoli, Yan, McEwen, & Sanacora, 2012). To limit such a destructive cascade of events, the introduction of a sense of control can reduce arousal and in turn restore HPA-axis regulation.

Controllable incongruence is a state in which a stressor (the incongruence) is raising arousal levels through sympathetic excitation and noradrenergic activation and may exceed a certain threshold to activate the HPA-axis, but the situation is perceived as manageable, and feedback loops to down-regulate the stress response in a timely manner are intact. Such a controlled stress reaction causes a moderate amount of adrenalin to permeate the nervous system, including the neurons, glia, and endothelial cells, which can facilitate a constructive response to the incongruence in the form of learning. As adrenergic receptors are stimulated at blood vessels and astrocytes, glucose release is increased with a corresponding increase in metabolism. This metabolic increase in conjunction with the release of neurotrophic factors from astrocytes (Verkhratsky,& Butt, 2007) and stimulation of adrenergic receptors will help stabilize neural connections activated when coping with the incongruence (in a process representing existing coping strategies) and also improve the facilitation of new neural connections (new coping strategies)—the opposite to what occurs in the uncontrollable situation. In fact, rising to the challenge of controlling incongruence is essential to "the formation of ever more complex and differentiated neural circuits to an optimal expression of [one's] genetic potential" (Grawe, 2007, p. 222).

As one continues to deal with a controllable incongruent situation, coping behaviour becomes more established, and eventually such situations will no longer elicit a stress response, as the neural networks required to effectively assess and cope with the situation are well established. This is a key goal of therapy: to strengthen existing coping skills and facilitate new ones on a neurobiological level of resilience. Such learning is not possible, on a neural level, in the overwhelming situation of uncontrollable incongruence where an overabundance of cortisol is hampering, even degenerating, synaptic connections. Within the safety of the therapeutic alliance, however, stress responses can be down-regulated to a state of optimal learning, and incongruence can be broken down into controllable, manageable parts to which new strategies can be applied.

In considering how to facilitate an effective therapeutic environment, Grawe (2007) points to what he calls *motivational priming* and *resource activation* as key elements for a controllable incongruence learning state (see also Flückiger, Caspar, Grosse Holtforth & Willutzki, 2009; Flückiger, & Grosse Holtforth, 2008). Motivational priming is the priming of the approach system via positive emotional experiences within the therapy session. Such a strategy would focus on positive need-satisfying experiences that are compatible with the client's goals, particularly at the beginning of the session, to provide some positive satisfaction of orientation/control, attachment, pain avoidance, or self-esteem enhancement needs. Establishing an effective therapeutic alliance is one example of a positive activation of a need (attachment) that would prime the client toward approach-orientated tendencies within the session. Resource activation is the therapists skill of identifying existing resources, characteristics, and abilities of the client that can be positively emphasised during the session in order to enhance the client's feelings of control or self-esteem and increase his or her tolerance for short-term increases in inconsistency during therapy (Smith & Grawe, 2003). This focus on the client's healthy psychological attributes is in contrast to the *problem activation* that is stressed in all major therapy schools, yet both play a role in explaining therapeutic change (Gassmann & Grawe, 2006). "Upon starting therapy or counseling, people seeking help often feel hopeless and have given up believing in their own problem-solving resources. It is therefore the counselor's job to reactivate the experience of that person's self-effectiveness. A counselor should pick up on the person's existing strengths and skills" (Flückiger, Wüsten, Zinbarg, & Wampold, 2009, p. 2). Ideally, motivational priming and resource activation should be facilitated early in the therapy process and emphasised throughout sessions. In this atmosphere of activated resources, therapy has a much greater chance of being effective (Gassmann & Grawe, 2006).

The feeling of safety within the therapeutic dyad is of fundamental importance to attenuate the destructive stress responses described above and to take advantage of controllable incongruence as a mechanism of change. A client who is held in a space of trust and security and can engage within their window of tolerance will be able to take advantage of the brain's natural neuroplasticity. Research has shown that "a safe, enriched environment actually facilitates the development of new neural patterns, which, in turn, leads to enhanced attachment and control, and stress reduction. Psychotherapeutic approaches that provide safe environments will thus enhance the positive social interaction that is an essential element of healthy neural proliferation" (Allison & Rossouw, 2013, p. 23). To establish such a safe environment requires a down-regulation of avoidance motivational schemas that may be activated. This is essentially a bottom-up approach of dealing with the physiological stress response before being able to facilitate effective neural change and proliferation (Allison & Rossouw, 2013; Rossouw, 2012b, c, 2013b). The affectively focused right brain-to-right brain therapeutic relationship, mediated via so-called "mirror neuron" activity, can be effective at establishing safety for a client by down-regulating limbic reactivity and communicating an empathic, supportive relationship that satisfies the basic need for attachment (Schore, 2012). A safe therapeutic relationship creates the ideal environment for facilitating neural proliferation in an integrative manner, as the nervous system is essentially a social-centric system that thrives on interpersonal love, acceptance, and security (Cozolino, 2014; Schore, 2012, Siegel, 2012).

When anxiety increases, there is a decrease in cortical blood flow in the left PFC and an increase in the right PFC, inhibiting the ability of the left PFC to modulate emotional arousal. When the left PFC is engaged and activated, as it can be in a safe therapeutic environment, more cortical blood flows to it, allowing it to modulate arousal generated by right cortical and limbic areas (The Neuropsychotherapy Institute, 2014d). This economy of blood flow within the central nervous system can effectively take certain areas such as the left PFC "offline" in order to provide a richer blood supply to more essential areas such as the right PFC and limbic areas in times of threat or danger. This works in much the same way that a sympathetic response can cause peripheral shut-down to shunt more blood to essential organs (The Neuropsychotherapy Institute, 2014d). Obviously a problem arises when the offline system is the very system required to down-regulate an over-reaction elicited by an overactive amygdala, in which case the feeling of uncontrollable incongruence only increases.

One of the ways to mitigate the problem of having an essential control system like the PFC go offline in times of stress is to increase its integrative connectivity to those areas that need higher-order control, such as the amygdala. Mindfulness is one practice that can achieve this. Described as focused attention in the present without judgment (Kabat-Zinn, 1994, 2013), mindfulness can increase mid-PFC and right anterior insula activity and thickening, and increase activity in the superior temporal gyrus and anterior cingulate (Badenoch, 2008). The result is an increased integration of these systems with the limbic system, providing better modulatory control over amygdala overreactions and fostering a propensity to approach rather than avoid challenging situations (Siegel, 2012). Such an increase in control brings previously overwhelming situations back into the realm of controllable incongruence. Research suggests that meditative practices like mindfulness not only increase the integration and plasticity of neural networks, but can also offset ageing processes and increase our ability to be present, attuned and compassionate with others (Badenoch, 2008).

Siegel (2007) suggests another "mindful" strategy to gain greater prefrontal management of limbic responsiveness that involves a change in our language. Rather than saying, for example, "I am sad", the self-talk that provides more separation between the self and the emotion would be "There is a feeling of sadness right now." Placing the emotion as an objectively observable phenomenon that is apart from the "observing self" elicits a greater sense of control over what would otherwise be an immersive emotional experience.

Whatever particular mindful strategy is utilised, there are some common outcomes to such practices: less dysregulation and reactivity to emotional experiences; remaining present with feelings, thoughts or actions without being distracted; the ability to label beliefs, opinions, emotions, and expectations; and having a nonjudgmental stance toward our experiences (Badenoch, 2008; Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006).

Motivational priming, resource activation, creating safety, and techniques like mindfulness are all designed to bring the client into a place of optimal learning where incongruence is perceived as within the client's window of tolerance, controllable, and therefore an opportunity for new learning and positive change.

4.2 Two-Person Psychology

There is an emerging emphasis on "two-person" psychology in therapy (Schore, 2003c), where right brain-to-right brain, embodied, affective, autonomic change between therapist and client becomes central to the therapeutic process (Marks-Tarlow, 2012; Montgomery, 2013; Schore, 2014). This places the spotlight on the neural integration within the therapist, in the sense that he or she must effectively operate out of a wide window of tolerance for the benefit of modulating clients on both an unconscious and a conscious level. In this context, therapy becomes less about the left hemisphere's desire to categorise and fix by applying discrete therapeutic interventions, and more about a right-hemispheric capacity for broad affective awareness, empathy, and connectedness. Such a perspective liberates the therapist from manualised techniques of intervention, yet necessitates the critical work of self-integration and the experientially developed intuition of attunement (see Badenoch , 2008, 2011; Marks-Tarlow, 2012, 2014 for resources to develop such integration and intuition). Vertical and bilateral integration of one's own neural systems is the first step toward an interpersonal integration within the dyad of psychotherapy. Vertical integration is the linking of body, limbic region, and cortex, thus increasing neural connectedness and facilitating a greater ability to stay in touch with empathic connections (resonance circuits). "When our middle prefrontal region is steadfast in its linkage with our limbic circuits and bodies, the flow of nonverbal information coming to us from our patients has a much greater chance of being held, with empathy as the most consistent underlying state. . . . Such interpersonal richness encourages GABA-bearing fibers to grow from patients' orbitofrontal cortex to the amygdala, calming old fears"

(Badenoch, 2008 p. 156). Bilateral or horizontal integration (Siegel, 2007) is the effective and balanced communication between left and right hemispheres where the left hemisphere is receiving a complete flow of information from subcortical and cortical regions on the right and contributes a complimentary yet subservient perception and response in accordance with the right's "big picture" perception. If such integration is intact within the therapist, he or she will be better placed to mediate a similar vertical and horizontal integration within the brain of the client.

Change within this two-person psychological system of client and therapist is primarily a right-brained, embodied, emotional, autonomic process within the dyad. Such biopsychosocial processes of affect regulation between therapist and client are forming the basis for a more integrative approach to treating mind and body. The somatic aspect of affect regulation is also becoming increasingly important in therapy (Schore, 1994, 2003a, 2012); for example, when the ventral vagal-mediated social engagement system is activated in a previously hyperaroused client by the regulating warmth and empathy of the therapist, the client's cortisol levels may return to the normal range while oxytocin and opioids validate the safe connection experience (Badenoch, 2008; Sunderland, 2006). The somatically attuned therapist will pick up cues from the face, body posture and reflexes of the client, and so focus on the effect of his or her own body posture, tone of voice, gaze, and so on in an attempt to bring the client back into a workable window of tolerance where the right amount of arousal can elicit optimal learning.

5. Defining Neuropsychotherapy

Many aspects to the meta-framework of neuropsychotherapy have been outlined in this paper, and reducing such a comprehensive approach to a succinct description is no easy task. The definition offered below is an attempt to capture the essence of neuropsychotherapy.

> Neuropsychotherapy is a neurobiologically informed framework for psychotherapy that conceptualises thought and behaviour as emerging from the influence of motivational schemata developed to preserve or enhance basic psychological needs. Therapeutic processes start from the development of a safe and enriched environment to activate positive approach motivational schemata utilising a bottom-up neurological approach, and proceed from a top-down approach to facilitate long-term change in neural architecture.

Summary

The pioneering work of Grawe introduced an approach to psychotherapy that was based on contemporary neuroscience (Rossouw, 2014). Shore, Siegel, and others have also established a scientific basis to psychotherapy with a particular emphasis on affective development and phenomena over cognitive processes. The rapid, implicit emotional processing of deeper brain structures requires the therapist to engage in psychotherapy that goes well beyond the traditional cognitive–behavioural understanding. In the meta-framework of neuropsychotherapy, clinical practice is informed by insight that has been gleaned by contemporary neuroscience and related disciplines. Grawe's challenge that "we ought to conduct a very different form of psychotherapy than what is currently practiced" (Grawe, 2007, p. 417) is today being addressed by a more sophisticated understanding and appreciation of the right-brained, affective, embodied, autonomic, and implicit processes involved in psychotherapeutic practice. Change is increasingly being conceptualised as a relational-affective process within the therapeutic dyad. The consistency theory model has provided a sound point of reference for the dynamics of mental functioning, possible sources of undesirable processes, and effective steps toward change. The continual development of a neuropsychotherapy perspective in conjunction with breakthroughs in neuroscience is even now providing clinicians with an unprecedented theoretical and pragmatic basis for effective client change.

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