MEDIROS CLINICAL SOLUTIONS

Neuropsychotherapy News

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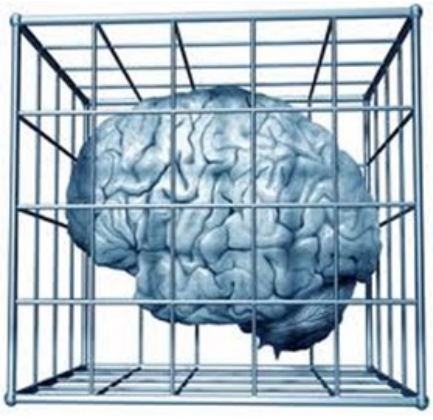
Editorial

Memory and Learning

In this edition we focus on memory and the brain. Understanding memory has been (and still is) tricky. We all have it but it is not a physical entity and it is—difficult to study. Slowly we are beginning to understand the neurobiology of memory – the role of neural networks, connections and more specifically the synapse.

How neural networks are established through experience has been the focus of attention in neuroscience for past decades. As the picture becomes clearer, more questions arise. How does experience shape memory?; how does memory shape who we are and how we behave?; can we change our memories?; can drugs/ electrical interventions shape our memories? And ultimately the question is asked – can enriched environments, like talking therapies assist in re-shaping memo-



These questions lie at the core of what we do as psychotherapists. If psychotherapy has no impact on memory and psychotherapy cannot assist in the re-shaping of memory then behavioural change is not facilitated and the key focus on well-being is not addressed.

Our main article in this edition attempts to provide an overview of the concepts of memory and learning in light of neurobiology and provides some directions regarding the role of Neuropsychotherapy in addressing memory and learning. This is the focus of one of our 2-day workshops "The Developing Brain and the Neuroscience of Memory and Trauma. Implications for Effective Skills Based Interventions" that will be presented later this year.

Workshops.

Our workshop program for 2012 is about to start. Over the course of the next two months the two-day Brain and Anxiety workshop will run in Sydney, Melbourne and Brisbane. We are also looking forward to the first of our one-day Skills Classes – the first being on applied strategies for the treatment of Anxiety disorders.

As these classes are round-table interactive workshops, there are very limited spaces and are filling up fast.

We are pleased to see so much interest by clinicians to take the information of the two-day workshops a step further to cement the information in effective clinical skills to apply in therapy.

Enjoy the read!
Pieter Rossouw

Neuroscience, learning and memory. From sea slugs to mental health

Pieter Rossouw (MClin Psych., PhD. MAPS, MCClin)
The University of Queensland and Director of Mediros Clinical Solutions

Current research indicate that circuits that contain these complex modifiable memory traces can be found deep in the centre of the brain

The terms *learning* and *memory* are often used as if they are observable entities.

When my students sit for a test, I have no means to test their memories and learning processes. The neurobiological activation of learning and memory cannot (at this stage) be directly observed. Learning and memory are implicated by the test performance.

Learning and Memory defined

Larry Squire's definition of learning and memory is widely accepted as the "classical" view: *"Learning is the process of acquiring new information, while memory refers to the persistence of learning in a state that can be revealed at a later time" (*Squire 1987).

New Learning

Early scientific research to understand memory and learning was conducted by Hermann Ebbinghaus who realised that, in order to study memory, you required a methodology that could distinguish between past learning and new learning.

He invented nonsense syllables – vowels placed between two consonants such as *zuh, gir, baw, hox, liy* and so on. They were all designed to be totally meaningless so that they had to be learned without the advantage of prior knowledge.

He studied the performance, performance curves and retention ability and found, for instance that performance is better if the repetition happens in shorter succession rather than longer succession (retention is better after 1 minute than 1 hour and even worse after 24 hours or even worse after 30 days) – the forgetting curve. He also found that retention is better when there are intervals in learning rather than ongoing exposure.

Ebbinghaus also indicated that there are short-term memory traces that decays relatively quickly and long-term memory traces that deteriorate more slowly (Ebbinghaus 1913).

The synapse and memory

Neuroscientists also stuggled with the phenomena of learning and memory. In the late 19th century Spanish neuroscientist Ramon Cajal formulated the famous neuron doctrine. He indicated that neurons communicate at points called synapses (in 1884 Freud referred to this as membrane barriers).

Cajal suggested that "the strength of synaptic connections – the ease with which an action potential in one cell excites (or inhibits) its target cell – is not fixed but is plastic" (translation – Squire and Kandel 1999).

Aplysia Californica

This suggestion – that the synapse is the fundamental unit of memory storage and that this unit is modifiable, formed the basis of the research by Erik Kandel and col-

By stimulating small subfields it is possible to trace the communication processes to various regions.

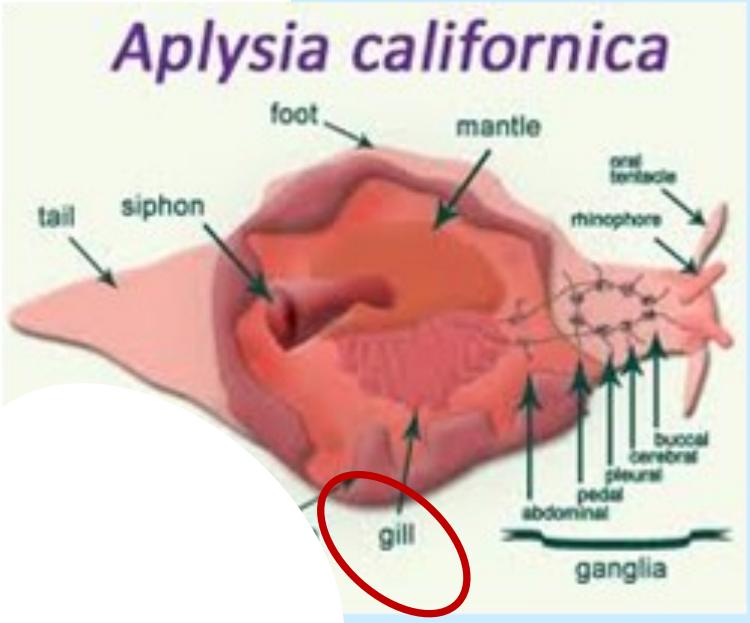
leagues on sea slugs and eventually demonstrated significant implications for understanding human behaviour as well as significant implications for treatment – therapeutic interventions to address learning and memory in general and mental health in particular.

Kandel

Psychiatrist and neurobiologist, Erik Kandel, believed that in order to understand the complexities of the human brain and its memory systems, we need to first understand the nervous system activity of the animal with the simplest system that can support a particular modifiable behaviour. He focused on an invertebrate *Aplysia Californica* – a large sea slug (about 15 cm long) with a simple but highly visible nervous system. The neurons are so big, they are almost visible with no magnification.

Habituation

The gill of the sea slug is the primary organ for extracting oxygen. The gill withdrawal reflex is a behaviour that the animal displays when its skin is stimulated. When the skin is touched, the gill contracts. The behaviour can be modified if the gill is touched every few seconds – the behaviour change happens when the spontaneous recover slows down – a process called habituation.



Short term habituation happens when the process is repeated briefly however eventually spontaneous recovery kicks in. If the experiment is repeated over several days – the amount of spontaneous recovery diminishes significantly – long term potentiation (LTP) (Kandel 2001).

Despite the groundbreaking work of Erik Kandel, the challenge was to find a similar neural system, network or structure in the human brain that remotely resembles modifiable synapses that would let us recall what we had for lunch two days ago and where we sat.

The human brain

Current research indicates that circuits that contain these complex modifiable memory traces can be found deep in the centre of the brain – in an area often referred to as the emotional brain or to use Paul MacLean's terminology – the limbic structures and more specifically the hippocampus (MacLean, 1990).

Currently it is not possible to study individual neuron to neuron connections in the hippocampus but fMRI and high resolution SPECT scans assist with the study of connections between small subfields of neurons. By stimulating small subfields it is possible to trace the communication processes to various regions.

Potentiation and the synapse

Early studies by Timothy Bliss and Terje Lomo indicated that a weak stimulus applied in this area evoked activity in the dentate

gyrus. They then found that a stronger stimulus evoked a bigger synaptic response. Then they found that repeated presentation of a weak response evoked a bigger response and that the potentiated response lasted several hours (LTP). This was the first indicator assisting us to understand learning and memory – it seems that experience in the brain is stored because it modifies the strength of synapses connecting networks of neurons and this process originates in the hippocampus (at least in terms of short term memory). Since these early study hundreds of studies were directed to explore LTP and how to utilise and maximise and shift LTP's.

These findings are of great importance to understand learning, memory formation and the effects of special experiences (like trauma) on the brain.

The sea slug contracts its gill when it is touched. This is a primitive protective response – to decrease its exposure to its environment to protect itself. In humans the neural circuitry has been studied extensively over the past decades with significant insights gained in the last decade.

Neural basis for fear

The midbrain – especially the limbic system has been identified as the neural basis for specific defensive behaviours that establish the fear system. Sensory information is relayed to the thalamus that alerts the amygdala, hypothalamus, hippocampus and basal ganglia. From there information systems to the neocortex are activated. The basic fear networks are formed in the early months after birth (Lambert and Kinsley 2011).

These systems become well established through a process of myelination of glial cells and neural pruning. Early experiences feed this system and assist in reinforcing the fear system. In a well established fear system the networks are mostly relaxed under the influence of gamma-aminobutyiric acid (GABA) that controls the firing of the network (Rudy2008).

In an upregulated fear system the network fires more often due to external "perceived" triggers. These triggers can be enhanced by significant events (trauma) resulting in changes in neural structure and more activation of the fear networks. These processes have a profound impact on behaviour, development of integrated neural firing (personality) and well-being, physical and emotional – both due to major changes in neural activation and neural firing.

Neural activation and talking therapies

Research by Furmark (2002), LeDoux (2007), Grawe (2007), Merzenich (1983), Sporns (2011) and many others, has indicated the effect on neural activation, chemical balance, neural firing, neural structure and neural networks through talking therapies.

Structured talking provides a supportive enriched environment that facilitates new neural connections, shifts in neurochemical release, down regulation of the fear response and eventually new neural connections.

Ongoing exposure to this type of enriched environment facilitates effective neural changes. The neurobiological information supports psychotherapeutic interventions that focus on the establishment of new neural connections. Interventions that focus on exposure that up regulates fear seems counterproductive (consider the sea slug's gill!).

The same principle applies as with the sea slug – unless the fear system experiences a resting state, the formation of new connections (new memory systems) will be compromised. There may be brief relief (catharsis/ ab-reactions/ tension relief) but new memory systems are not facilitated and clients become reluctant to continue with the interventions (high levels of too much emotional discomfort).

Interventions

The basic neurochemical and neurosystemic indicators point towards the need to facilitate new neuro-electrical and neurochemical balance – which is more than chemical therapy as the neural networks need to be addressed and we do not have access to smart chemicals that only activate small localised areas in the brain.

As a result generalised pharmachological interventions often lead to a wide array of side-effects. Psychological interventions on the other hand are proven to be able to target specific neural networks (as demonstrated on fMRI and PET scans) resulting in targeted interventions to activate new neural connections and replace looping networks.

The ongoing challenge of psychological interventions is to refine the clinical interventions to maximise the formation of effective neural networks and assist in the deconstructing of default (unhelpful) neural patterns.

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Aplysia Californica

Books on Neuroscience:

Jerry W. Rudy.

The Neurobiology of Learning and Memory.

Massachusetts, Sinauer Associates. 2008.

The Neurobiology of Learning and Memory is a textbook that provides a synthesis of this interdisciplinary field. Each chapter makes the key concepts transparent and accessible to a reader with a minimal background in either neurobiology or psychology and is extensively illustrated with full-colour photographs and line art depicting important concepts and experimental data.

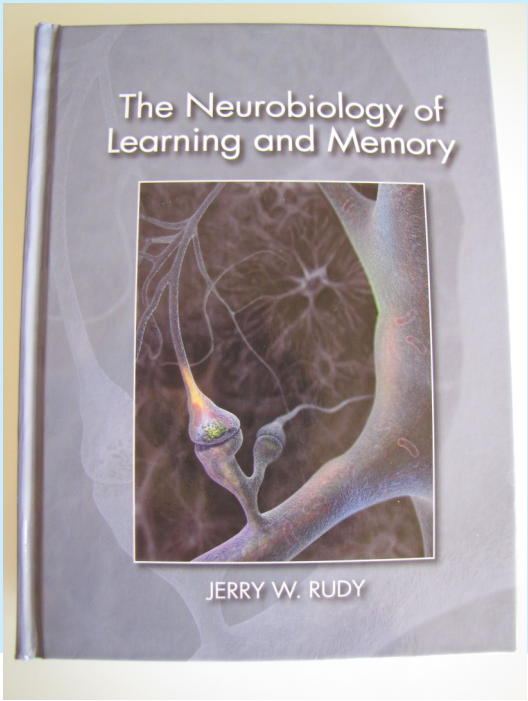
The first section of the book is organized around the central ideas that synapses are plastic and can be modified by experience and that the synapse is the basic unit of information storage. It introduces readers to the long-term potentiation methodology used to study how synapses are modified, the concepts of post-translation processes, genomic signaling processes, local protein synthesis and synaptic tagging, and how they contribute to strengthening synapses.

It emphasizes the various ways in which calcium regulates processes that strengthen synapses and ends with a discussion on the structure of dendritic spines and how changes in the spine s structure contribute to its function and stability.

The second section builds on this foundation to show how molecules and cellular processes that have been identified from studies of synaptic plasticity also participate in the making of memories. It features a discussion of the basic conceptual issues researchers face in trying to relate memory to molecules and describes some of the behavioural and neurobiological methods that are used.

This section also introduces the concept of memory modulation and discusses the fate of retrieved memories and how they can be modified. The final section of the book is organized around the multiple memory systems view that different neural systems have evolved to store the content contained in our experience. It features discussion of the medial-temporal hippocampal system that supports episodic memory, the concept of systems consolidation, and its relationship to Ribot's law that memories become resistant to disruption as they age.

The cortico-striatal system and its relationship to what are called behavioural actions and habits is described, and this section ends with a discussion of neural systems involved in the acquisition and removal of emotional memories.



Workshop dates 2012

(register at www.mediros.com.au)

2-Day Workshops

The Brain and Anxiety –
Utilizing Neurobilogical Information as Psychotherapeutic Tool
APS Endorsed 12 CPD hours
(CCLIN, CCOUN, CCOM)

- 28,29 April 2012 – Sydney
- 20,21 April – Melbourne
- 1,2 June - Brisbane

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The Neuroscience of Depression –
New Opportunities for Effective Treatment
APS Endorsed 12 CPD hours
(CCLIN, CCOUN, CCOM)

- 11,12 May 2012 – Perth
- 18,19 May 2012 – Canberra
- 25,26 May 2012 – Adelaide
- 15,16 June 2012 – Melbourne
- 22,23 June 2012 – Sydney
- 6,7 July 2012 – Brisbane
- 13,14 July 2012 – Hobart

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The Developing Brain and the Neuroscience of Memory and Trauma.
Implications for Effective Skills Based Interventions.
APS Endorsed 12 CPD hours
(CCLIN, CCOUN, CCOM)

- 7,8 September 2012 – Melbourne
- 14,15 September 2012 – Brisbane
- 21,22 September 2012 – Perth
- 12,13 October 2012 – Adelaide
- 26,27 October 2012 – Canberra
- 2,3 November 2012 - Sydney
- 9,10 November 2012 – Hobart

1-Day Skills workshops

Focused Neuropsychotherapy – Applied strategies for the treatment of Anxiety – skills based training

(1 day round table class – case demonstrations, discussions and interactive learning)
(limited spaces)

APS Endorsed—6 CPD Hours
(CCLIN, CCOUN, CCOM)

- 24 March 2012 - Brisbane
- 14 April 2012 – Adelaide
- 2 May 2012 – Melbourne
- 30 June 2012 – Perth
- 21 July 2012 – Sydney
- 1 September 2012 – Canberra

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Focused Neuropsychotherapy – Applied Strategies for the treatment of Depression – skills based training

(1 day round table class – case demonstrations, discussions and interactive learning)
(limited spaces)
6 Learning hours

- 18 August 2012 - Adelaide
- 27 September 2012 - Sydney
- 5 October 2012 – Hobart
- 17 November 2012 – Melbourne
- 1 December 2012 – Canberra
- 8 December 2012 – Brisbane
- 15 December 2012 – Perth

Mediros Website.

Our website is now active with registrations available for all workshops and skills classes. Discounts apply for skills classes when accomopanied by registration for a 2-day workshop. Discounts also apply for group bookings (4+)

www.mediros.com.au

Contact us:

If you have any further questions or comments about the newsletter or interest group, or to subscribe, please contact us at **admin@mediros.com.au**

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