

Neuroscience and Faith Formation

Recent advances....

More accurate views of human nature and behaviour has come through the integration of

- psychology (study of human mind and human behaviour); and,
- neuroscience (study of anatomy and physiology of brain)

These advances have been applied across a wide range of disciplines even in to the field of neurotheology; and have been possible with the increased capacity of magnetic resonance imaging.

Brain anatomy & function (Ref.: Glick 2011)

This paper and presentation does not purport to offer any sophisticated level of understanding the brain anatomy and functioning, nor any capacity, competency or intention to delve deep into neuroscience. What is offered is a lay person's overview for the purposes of giving a 'first glance' at what we, who are passionate, in the endeavour of faith formation for discipleship and ministry might begin to explore and implement.

Firstly a high level snap shot of the brain anatomy and function.

Cerebral Cortex – Basal Ganglia



The cortex is the outer covering of the brain, the curly grey stuff you see in pictures of the brain. It's a 10th of an inch thick and covers the brain like a sheet.

Every memory – every piece of data, idea, habit, thought – is made up of a set of connections among neurons, like a map of connecting highways in our brain. Each map or set of connections involve some 10,000 to 50,000 neurons. We create maps for every sight, sound, word, face, person, idea and memory that we remember consciously or not. Everything that stays with us forms a map that is part

of our brain. These maps are hard-wired into the brain.

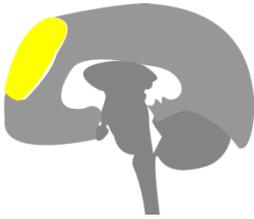
The basal ganglia are four masses in the brain region driving routine activities that don't require a lot of active mental attention. From an evolutionary perspective, the basal ganglia are an older part of the brain. They are highly energy efficient. As soon as you repeat an activity even just a few times, the basal ganglia start to take over. The basal ganglia recognise, store and repeat patterns in your environment. E.g. "if you pick up a hot drink, don't gulp it straight down; test it with a tiny sip first." This routine is stored in complex maps. Each map contains the instructions for firing millions of nerves to move hundreds of muscles in just the right order, for just the right length of time, and with just the right strength, to pick up a hot drink in a mug with a handle and bring it to your mouth and sip it.

The basal ganglia have a finger in every pie! The well-wired basal ganglia pick up patterns not only in physical movement, but also in light, sound, smell, language, events, ideas, emotions and in all other perceived stimuli.

The basal ganglia have an appetite for patterns. One study showed that only three repetitions of a routine is enough to begin the process, of what we are calling 'hard wiring'.

We build up these layers of maps for experiences throughout our lives. These maps are constantly competing for resources, as there is not enough energy for every neuron to connect with every other possible one form moment to moment. So the brain prunes neurons, thus erasing unused connections, as we go along. This is a fundamental principle of the way our thinking works at a physical level: our models of the world are constantly changing and reconnecting. Maps that convey information that is most accessed get further hardwired into our brain and become more likely to be activated in the future.

The Pre-frontal Cortex



The prefrontal cortex, which sits behind the forehead, is just one part of the cortex. The last major region to develop during human evolutionary history, it is a measly 4 to 5 percent of the volume of the rest of the brain.

The prefrontal cortex is the biological seat of our conscious interactions with the world. It's the part of the brain central to thinking things through.

A metaphor for the prefrontal cortex is the stage in a small theatre where actors play a part. The actors represent information that you hold in your attention.

Sometimes the actors enter the stage as a normal actor would, from the side of the stage. This is the case when information from the outside world comes to your attention.

However, sometimes the actors might also be audience members who get on stage to perform. The audience represents information from your inner world: your own thoughts, memories and imaginings. The stage is what you focus on at any one time, and it can hold information from the outside world, information from your inner world, or any combination of the two.

It is possible to bring actors or audience members on to the stage or to inhibit certain actors off the stage. This takes a lot of effort.

The stage needs a lot of lighting: conscious mental activities chew up metabolic resources, the fuel in your blood, significantly faster than automatic brain functions such as keeping your heart beating or your lungs breathing. The five functions, understanding, deciding, recalling, memorising and inhibiting make up the majority of conscious thought. These functions are recombined to plan, problem-solve, communicate and other tasks.

There are three limitations to the pre-frontal cortex: the stage takes a lot of energy to run, it can only hold a handful of actors at a time, and these actors can play only one scene at a time. While it is physically possible sometimes to do several mental tasks at once, accuracy and performance drop off quickly.

The Limbic System



Emotional experience is connected to a large brain network called the limbic system. The limbic system includes several brain regions. It tracks your emotional relationships to thoughts, objects, people and events. It determines how you feel about the world, moment to moment. It drives your behaviour, often quite unconsciously.

The limbic system scans data streaming into the brain, telling you what to pay attention to, and in what way. Emotions such as curiosity, happiness and contentment are toward responses. Anxiety, sadness, and fear, on the other hand, are away responses. The limbic system is constantly making toward or away decisions. These decisions happen automatically, about half a second before you are consciously aware of them if you become aware of them at all.

As well as being more anxious than happy, the limbic system fires up far more intensely when it perceives a danger compared to when it senses a reward. The arousal from a danger also comes on faster, lasts longer, and is harder to nudge. The 'toward' emotions are more subtle, more easily displaced, and harder to build on, than the 'away' emotions. Human beings walk toward, but run away.

Everyone has a unique set of 'hot buttons' that can trigger limbic system arousal. Such hot spots are patterns of experience stored in your limbic system and tagged as dangerous.

When such limbic responses are aroused they reduce brain functioning that supports creative thinking, problem solving and big-picture planning. When there are not enough resources for conscious processing the brain becomes 'automatic', drawing on either deeply embedded functions or recent events. Clear thinking goes missing when the limbic system is aroused and you are more likely to respond negatively to situations. The limbic system, superconscious of the dangerous side of life, looks out for even more danger

when aroused by threat. An aroused limbic system increases the chance of making links where there may not be any or in misinterpreting data.

When you experience over-arousal over a long period of time you experience a permanent sense of threat, and a low threshold for additional threats.

Insights into Brain functioning (Ref.: Rock 2006:1-29; Results Coaching System 2008:43-44)

A. The Brain is a connection machine

- Every thought we have is a map connecting many points across the brain.
- We create millions of new maps every second – some are short term, some become part of us.
- Everything goes along well until some of our maps can't be reconciled.
- A mental impasse has been reached, which we keep going over until it is resolved.

B. Up close, no two brains are alike

"There are more possible ways to connect the brain's neurons than there are atoms in the universe" (Ref.: Ratey 2003:20)

C. The brain hardwires everything it can

Working memory

(Several pieces of information at once)

VERSUS

Hardwiring

(trillions of pieces of information at once)

"The brain is constantly trying to automate processes, thereby dispelling them from consciousness; in this way its work will be completed faster, more effectively and at a lower metabolic level. Consciousness, on the other hand, is slow, subject to error and 'expensive'." (Ref.: Roth quoted in Rock 2006:12)

D. Hardwiring drives automatic perception

- Every brain sees the world differently, based on its hardwiring.
- We can override this hardwiring and consciously influence our perceptions.

E. It is hard to deconstruct old wiring

- It is an attention economy brain. (The brain is lazy and only hardwires that which it gives attention).
- The more focus we give any circuit, the more we deepen that circuit in the brain.
- You cannot change or get rid of wiring by looking for why it exists.

F. It is easy to create new wiring

- We are constantly making new maps.
- We reconcile dilemmas by creating new maps. This occurs in a moment of insight.
- New maps can become hardwiring with enough attention and positive feedback.
- These can come from ourselves or others.

Neuroscience and learning (Ref.: Glick 2011)

When the brain detects an 'error' i.e. perceived differences between expectation and actuality the signal is generated in part of the brain closely connected to the fear circuitry.

Thus if we define learning as changing or growing our understandings it may be that learning, for some, can be uncomfortable or even painful. In this experience:

- To change our thinking can often be experienced as discomfort.
- The brain sends out powerful messages that something is wrong, and the capacity for higher thought is decreased.

The neuroscience suggests that our attention is a powerful tool in learning, that is, focus is all-powerful. When we focus (not multi-task!) we...

- stabilize the brain circuits;
- maintain the brain state arising in association with that experience;
- over time create changes in the physical connections in brain's circuitry;
- change and reshape the brain dependent on where we place our attention.
- We also learn that when we expect certain things, then that is most likely what we find which in turn shapes our reality. For example, when we listen to politicians we may expect to hear certain biases or emphasis and often that is exactly what we hear. We fail to hear all the other things that didn't fit our expectations.
- Mental maps (theories, expectations etc.) play a central role in human perception. E.g. the placebo effect.
- Cultivating moments of insight can change mental maps
- At the moment of insight, a complex set of new connections is being created. We need to hard-wire an insight by paying it repeated attention.

Finally, we discover that where we place our focus and attention is what most shapes who we are and how we are. If I only read one sort of book, listen to one political perspective, hear one theological perspective – that will gradually shape our identity. Also for insights and new learning to be useful they need to be generated from within, not given to individuals as conclusions.

- People will only experience the adrenalin rush if they go through process of making connections themselves.
- Human brains are so complex and individual there is little point in trying to work out another's thinking rather it is more effective to assist another in coming to their own insights.

Principles of Effective Faith Formation

The consequences for learning from these highlighted aspects are worth exploring and informing our practices for faith formation.

We can, thus identify key principles of effective formation (Ref.: Rock 2006: 29ff)

Self-directed learning – when we make the connections for ourselves we are much more likely to embed them in our memory.

Solutions Focussed – the neuroscience indicates that we are much more available for learning in an attitude of solutions focus rather than problem-avoidance or defensive posture. Our brains release more creative juices when we are solutions focussed.

A Toward State – feeling open and positive creates a greater capacity to engage and reflect compared with defensive or negative which shuts our brain down. When threatened the brain releases cortisol which

- remains in the bloodstream for an extended period of time
- and this chemical causes damage to the part of the brain involved with memory and thus impairs learning

Positive Feedback – there is a 4 to 1 : 'praise –to – criticism' ratio, that is for every 4 affirmations we receive it only takes one negative criticism to capture our attention. Praise/affirmation releases brain chemical endorphins leading to a sense of wellbeing.

Stretch – just like our muscles, gentle stretching and then relaxation creates the ability to extend ourselves further. New information or insights which may stretch our previous perspectives means we may need space to return to a safe position to reflect on the learning. Being stretched constantly beyond our capacity may lead to 'switching off'.

Structure – our brains like structure and frameworks in which to position new insights. Thus our learning needs to be scaffolded to enable the brain to locate and position new learning and build the new maps.

Conclusion

To create an effective environment for formation and learning, we need at least 5 things... (Ref.: Bruce 2003)

- A safe environment – devoid of negativity and criticism
- Designed to create meaning with the learning and experiences scaffolded as the brain is more adept when it knows what to look for with advanced organisers give the brain clues as to what to notice and how to link information and experiences
- Sharpened by problem-solving and creativity. There are (at least) 7 different intelligences: verbal/linguistic, musical/rhythmic, logical/mathematical, visual/spatial, body/kinaesthetic, intrapersonal (reflective), interpersonal (social intelligence), and Spiritual (?). There are many pathways through which to engage and extend our faith.
- An enriched environment - the brain thrives on an enriched environment. The environment teaches us, we do not learn or live in a void – nothing is neutral.
- Deprived of stimulation brains atrophy, dendrites shrivel and the brain begins to slow down.
- The opposite is also true, stimulation keeps the brain flourishing
- Reflection is critical to understanding. The brain needs time to make connections and strengthen synapses
- If you can't explain it to someone else you haven't learnt it!

What I have learnt from neuroscience that impacts my own formation

- Fear and change decrease the brain's capacity to navigate to find creative pathways through tough times.
- A toward posture gives me greater capacity to problem-solve.
- I can keep making new connections and insights – I am not my past!
- Where I place my attention will create my identity – both for good and for not-so-beneficial outcomes.

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There are any number of books and articles on neuroscience.

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