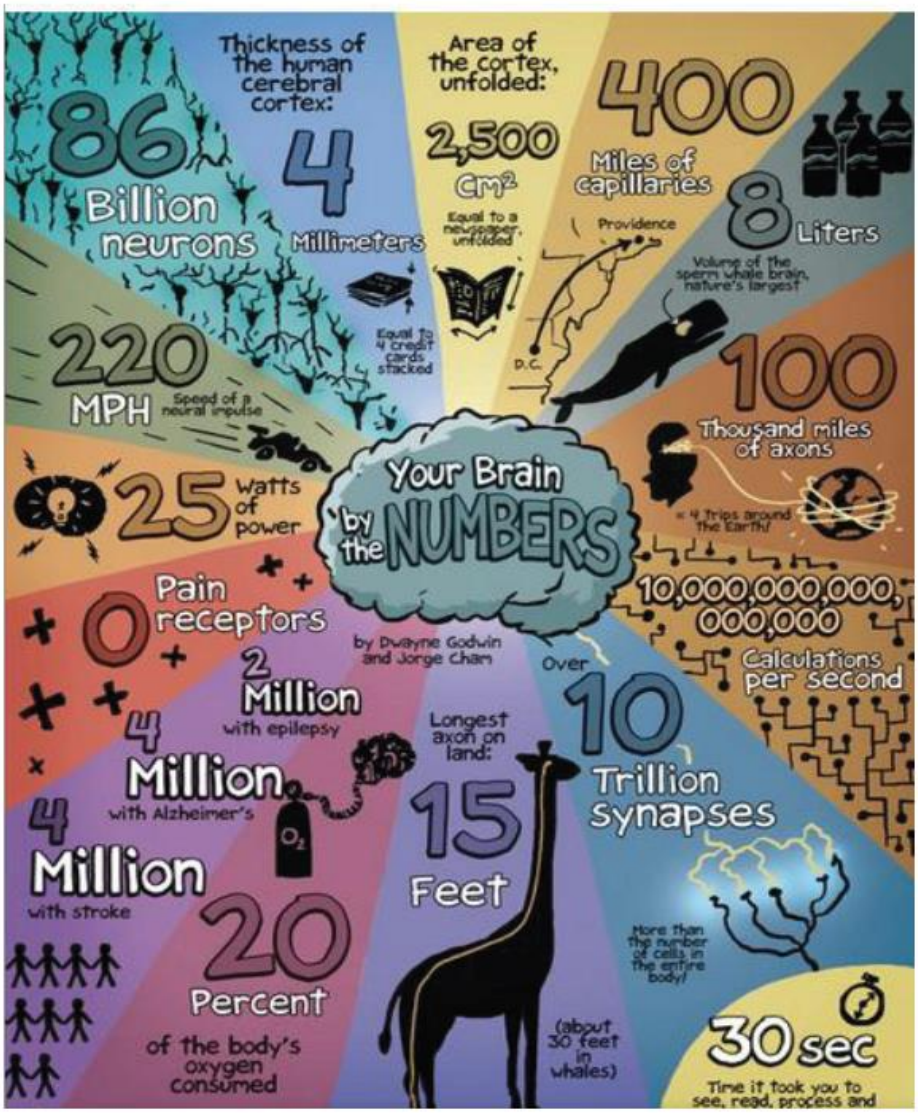
# Neuroscience

## Introduction

Medical **Definition of NEUROSCIENCE**: a branch (as neurophysiology) of science that deals with the anatomy, physiology, biochemistry, or molecular biology of nerves and nervous tissue and especially their relation to behaviour and learning. In an age where science is beginning to inform us about what actually happens in the brain at an emotional (e-motion = energy for action) level and at a neuro chemical level we can begin to have an insight into to how the brain might be responding in a coaching session.

The brain works as an energy management system. It is driven by the energy attached to the emotions responding to external and internal stimuli. Let's examine how our brain and nervous system operate and how our emotions are created through our brains reactions to circumstances and how our brain can become 'hijacked' by negative experiences and the emotions they create.

Some key facts about our amazing brain:



## Our Brain & its Neural Pathways

Imagine being a brain. You're locked inside a bony skull, trying to figure what's out there in the world. There are no lights inside the skull. There's no sound either. All you've got to go on is streams of electrical impulses which are only indirectly related to things in the world, whatever they may be. So, perception - figuring out what's there has to be a process of informed guesswork in which the brain combines these sensory signals with its prior expectations or beliefs about the way the world is to form its best guess of what caused those signals. The brain doesn't hear sound or see light. What we perceive is its best individual guess of what's out there in the world.

The way our brains are built, from before we are born and throughout our life, is a bit like a landscape map of the life experiences and memories we have had to date. Neural pathways are created and reinforced based on the experiences we have had. Sometimes these pathways are useful in achieving what we want and sometimes they take us to emotions and feelings and behaviours that are not so useful.

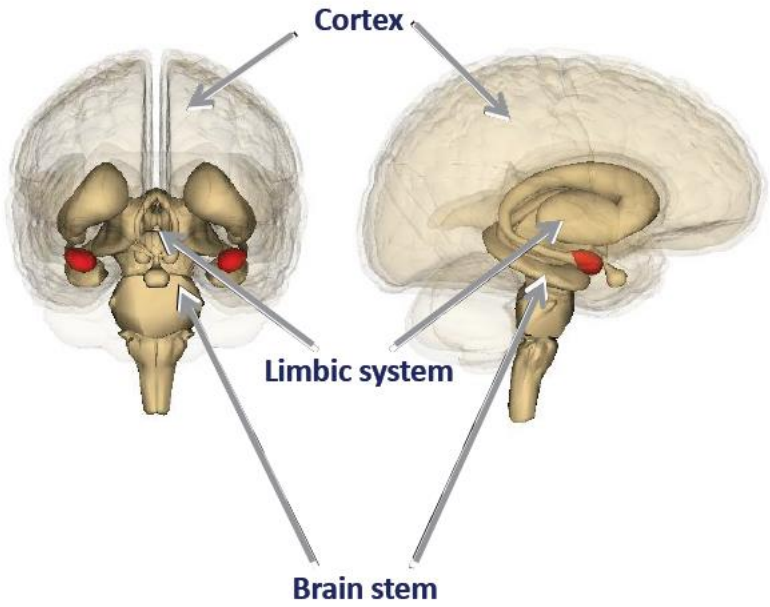
One of the critical functions of the brain is to encode and store information, which becomes our memories. Our different memories provide us with insight into events and knowledge of the world around us and influence our actions and behaviours – forming important aspects of our personality. It is proposed that long-term memories become integrated into the cerebral cortex and our subconscious brain (responsible for the higher order functions that make us human). This process is referred to as cortical integration; it protects the different information that each of us stores in the brain.

## Personality

Our different personality types also create different pathways and activity in our brains. For example, novelty seeking leads to exploration and individuals high in this trait are curious, quick-tempered, impulsive and easily bored. They have increased activity in the basal ganglia, which are clumps of neurons sitting in the middle of the brain. This trait has also been linked to the so-called pleasure molecule dopamine, which acts on the basal ganglia, and changes in this pathway are associated with seeking novelty in different ways.

Interaction of networks regulating temperament and emotion leads to the emergence of individual personality. It is important to emphasise that no particular personality characteristic comes from a specific brain region, as the brain operates as a complex network. However, the neuronal circulatory is individual to each of us like a fingerprint.

## The Triune Brain




The picture shows the structure of the human brain - called the Triune or 3-part brain. This refers to the way in which the brain is believed to have evolved. The central part of the brain attached to the brainstem and spine is called the **Reptilian brain**. It deals with the autonomic nervous system and our instinctive responses. It enables us to keep breathing, our heart to keep beating etc. In his book *'The Little book of big stuff about the Brain'* Andrew Curran provides an amusing take on the 27 known behaviours of most lizards in which he describes as mostly being about moving from warm to cold or cold to warm, the most exciting of which is how to look either big or small to another lizard depending on your chances of coming off well in a fight! We have moved quite a bit beyond this small list of reptilian needs!

The Second part of the brain is called the **Mammalian (or Limbic) brain** – this is so called because mammals were the first animals to give birth to live young. These young are incapable of looking after themselves for some while (the longest time in humans) after birth and this required mammals to have a brain that was geared to nurture and protection. This part of the brain governs our emotions and holds the gateway to our memories and is made up of structures such as the hypothalamus, hippocampus and the amygdala.

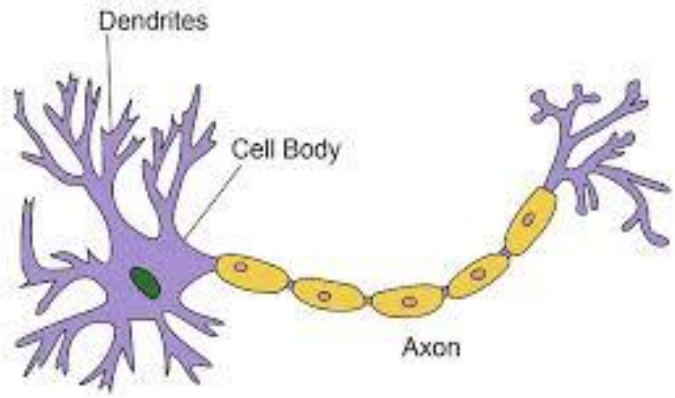
The gateway to the whole brain is through the almond-shaped **Amygdala** in the mammalian brain. We have 2 of these on the right and left side of our brain. They are effectively scanning the world for information about how safe we are – they are looking for stimuli that excite the brain either in a positive way or in a threatening way. Where the stimulus goes to in the 3rd part of the brain is determined in the first instance by our past responses. The amygdala attaches emotional significance to events and memories. It came to the attention of emotion researchers in 1939 when monkeys whose amygdalae were removed showed bizarre patterns of behaviour. They became fearless, hypersexual and either devoid of emotion or irrationally aggressive.

The third part of the brain is the **Neocortex**. This is the piece that we have developed beyond any other animals. It has evolved as we have. Our brains have got larger and more complex the more complicated our societies have become. And this part of the brain provides us with consciousness, the ability to think about ourselves, that very human of capabilities. It does this by dealing with abstract thinking, reasoning, imaging, deciphering and creating language, making sense of emotions etc

It has the capability to consciously interact with the other parts of the brain to regulate or react to emotions and to create choice and possibility beyond the core of our brains, differentiating us increasingly over time from other mammals.

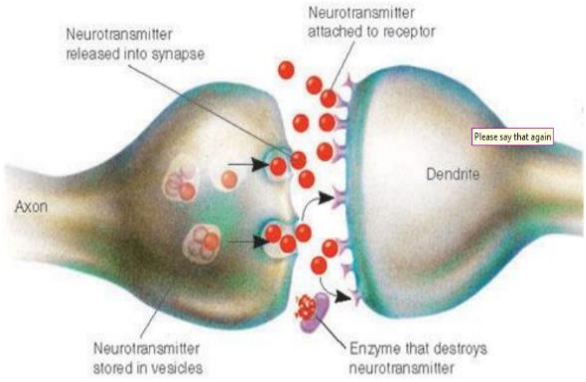
## The Nervous System

The nervous system is made up of nerve cells called neurones – each brain has over 100 million neurons, each one capable of making 10,000 connections – these connections are shaped from our life experience.




Our senses send information in the form of electric signals along the neurones and where they meet at a synapse or gap they secrete chemical neurotransmitters, such as serotonin and dopamine, acting as chemical messengers sending signals across the network neurones. Brain regions receive these signals, which results in us recognising objects and situations, assigning them an emotional value to guide behaviour and making split-second risk/reward assessments.

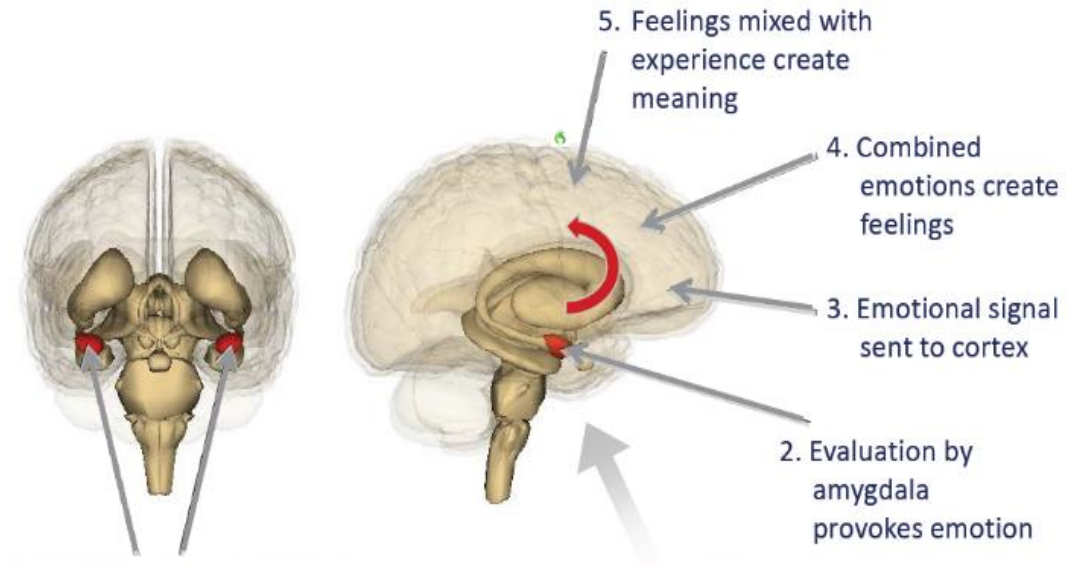
## Neurotransmitters – action at the synapse




### Neuroplasticity

In order to learn / experience something new or have a new way of doing something, new neural pathways must be built. This ability of the brain to develop new pathways is known as neuroplasticity. An excellent example is demonstrated in London taxi drivers who have learnt "the Knowledge" (all the roads of London without needing to refer to a satnav) have increased grey matter in the back part of their hippocampi – (the area of the brain related with memory) - when compared to those who weren't professional drivers.

## Making meaning of events




**Amygdala** - act like 'radars', attaching emotional significance to experience and subsequently evoking an emotional response

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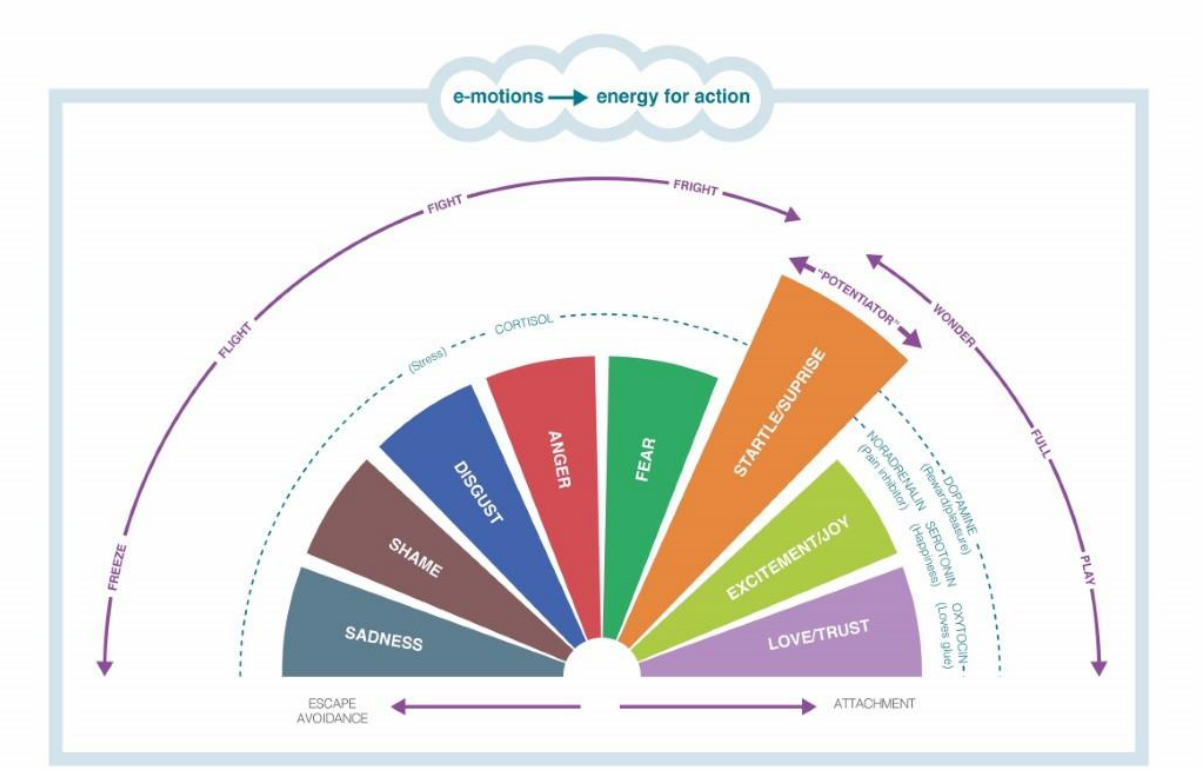
There is considerable evidence that people with higher intelligence, as measured on psychometric tests, have larger brains on average. Geniuses whose brains have been studied and found to be large include Carl Gauss (mathematician), Rudolf Wagner (composer) and Vladimir Lenin (political leader), although there are also many exceptions to this rule.

Each of our different individual brains leads to different behaviour patterns and responses conciously reflecting on and understanding our difference can help us as leaders rethink our communiction styles in order to maximise our influence.

## Emotions




### What is an Emotion?

"An emotion is a complex psychological state that involves three distinct components:

- a *subjective experience*,
- a *physiological response*, (changes in neurotransmitters, neurons, hormones, magnetic fields + bodily changes in heart rate, face flush, breathing, sweating, pulse rate)
- a *behavioral* or *expressive response*." (Hockenbury & Hockenbury, 2007)

Emotions are:

- Part of our evolution and our survival mechanisms
- They are fast – 80ms to register an emotion - 250ms to register a thought
- Information connected to an emotion is more likely to become a long-term memory
- Emotions are contagious

Stimuli are registered by the Amygdala. A stimulus acts as a 'potentiator' startling the amygdala into action and creating an almost instant emotional response – either towards the anger, sadness, disgust, fear side of our emotions or the joy, love, excitement side. It achieves this by sending signals to release the main hormones associated with emotion:

**Adrenalin and Cortisol** – prevalent to get us to act, protect, defend
**Serotonin and Oxytocin** – creating happiness and bonding
**Dopamine** – giving pleasure and reward
**Noradrenalin** – inhibiting pain

Stimuli which are not high as potentiators will pass our amygdala by – for most of us that is most stimuli that we experience each day. We are unlikely to be startled by things which are familiar, unless we already have a high level of adrenalin and cortisol in our blood. Then we may find small simple things have 'potential' emotionally. So, when we are stressed or depressed we respond to more stimuli in a negative way throughout the day, creating a vicious cycle of stimulus/response.

## Amygdala Hijack

We know when our amygdala has been 'frozen' by it's own responses when:

- You can only think about what's troubling you
- Memory is poor and you can only remember what's relevant to the threat
- You can't learn anything new – rely on old learned patterns
- You can't innovate or be flexible

This will affect our self-talk and hence our self-image, our self-esteem is often affected and depending on our particular wiring we may be highly irritable/angry or sad and down.

An amygdala hijack can occur temporarily or as a more ongoing state. It is triggered by different things in different people. An important part of becoming self-aware is to identify your unique triggers. **Triggers** can be tangible things from inside or outside of you - your own thoughts, your senses (smell, taste etc.) or even dreams; others feedback or actions.

Triggers can also be your attitudes, habits and beliefs. They are held in your subconscious and therefore the majority of your triggers are learned. You can learn to adapt your behaviour once you become aware of the trigger and what your emotional response was. When you can identify triggers that might cause you to take regrettable action, you can either prepare yourself for those situations or learn to look at those situations differently.

You can learn to recognise the emotion as it begins to register with you and intervene. A good example to explore here is public speaking. Although not a universal (inherited) fear, it is quite a common fear. In this case, the anticipation of public speaking activates your amygdala which checks with previous experiences at lightning speed and triggers your blood chemistry changes and your emotional response. This is evident in your body e.g. sweaty palms, tightness of chest, shaky legs or hands; and your mind – inhibiting self-talk.

Sometimes, just with practice you overcome those responses to a lesser or greater extent. You can build up an anti-reaction in your cortex that says it went OK last time. You can facilitate your learning with positive self-talk e.g. "it's not fear – its excitement!". You can purposefully use your physiology

to take a more powerful pose and 'act as if'. All of these come from conscious, purposeful use of your cortex's amazing resources.

### Typical triggers

Anger – having one's goals blocked
Fear – threat of harm to welfare
Sadness – loss of something of value
Disgust – blocking of offensive object or action
Surprise – preparation for action
Joy/Excitement – pleasurable sensation, object or action

### Impact of our beliefs

Our beliefs will affect how we perceive an event and distort it. Understanding our own beliefs and recognising the story we are telling ourselves in our self-talk is key. For example, our interpretations of the triggers above might be:

- *Having your goals blocked* – ***interpreted as a violation of your rights***
- *Loss of something of value* – ***interpreted as a loss of self-worth***
- *A potential threat to your welfare* – ***interpreted as a future threat to actual welfare***

Your attitude is intrinsically linked to your beliefs and therefore to how you interpret triggers.

### Stimulus > Gap > Response

Each trigger will typically create an instant judgement/assessment/interpretation and most of our responses will be based in our auto-pilot of beliefs, habits and attitudes.

**"If you always do what you've always done, you will always get what you've always got"**
**Henry Ford**

If we want to do something different and get something different we will have to put a gap in between the stimulus and the response!

### Creating a 'Gap'

At the speeds our brain works that might sound like a tough call! And yet we've been doing it throughout our evolution…let alone our current life times. So how?

What you need to create is some kind of 'pattern interrupt'. That is some stimulus that will trigger the brain to do something different this time. These can take many forms:

- Just thinking consciously about your trigger and what you do already and what you want instead can be enough- creating that cognitive dissonance – and then moulding that into discrepancy production by creating a new compelling outcome can really help your brain to take a new path.

- You may need an external trigger - something you can see near you when this situation occurs. An image, an object and few words on a post-it can all cause you to take a breath and

give you an option to do something different. For example, the person who put a purple post-it at head height on the inside of their door frame, when someone popped their head round the door…next to the head was the post-it. The minimum it did was make them smile, the maximum was to take a breath and respond in a way that supported their pacing and outcome.

- We can choose an emotion to have – we can prepare ourselves for a tricky encounter by deciding to see the positive in it, going in with our best foot forward, remaining calm (remembering a time when we were calm and replaying that image over again to give us the associated feeling)

- We can ask ourselves a question – in the typical triggers above - knowing that these are often the reasons for our emotions we could ask ourselves…'Which goal is being blocked then?' or 'What is the real threat here?' which will help us to pause and reflect before acting.

There are many ways to create a gap!

## Emotional Resilience

Choosing your emotional response requires you to choose how to direct your energy. Different emotions bring about different energy to support you in your chosen course of action and you can choose how and where you direct that energy. For example, do you direct your energy at undermining a proposed change because you don't agree with it, or do you direct your energy toward creating an even better solution than the one proposed?

Luckily our cortex (particularly the Pre-Frontal Cortex) is there to help! It has developed the major role of mitigating our response to events in 9 distinct ways:

- regulating our nervous system so we stay calm and engaged
- quelling the fear response
- regulating emotions so resilience is not blocked by fear or shame
- attunement – the safety and trust of "feeling felt"
- empathy – the safety and trust of being seen, known, understood
- response flexibility – the capacity to pause, recognize and evaluate options, and make appropriate decisions
- insight – self-awareness
- intuition – the guidance of our gut feelings
- morality based on a sense of connection with others and the common good

We may experience a slight emotional reaction, and our cortex can then assist us in making sense of the situation and bringing the logic and rational side to bear. This is at the heart of our resilience.

People who are resilient in their feelings are more emotionally intelligent. They are self-aware of the emotions that they are feeling and the causes of those emotions. They embody positive attitudes and beliefs and they exercise choice in their emotional responses. They can discriminate between the present situation and past situations and their attitudes and beliefs can be applied in a flexible way.
People who are not emotionally resilient allow their feelings to cloud their judgement and typically have set responses to situations which they perceive on the outset to be the same. They do not consider how their behaviour impacts on other people and have little or no regard for the emotional state of others.

A lack of emotional resilience is characterised by ignoring or refusal to acknowledge emotional states, seeing emotions as either good or bad, being judgemental of emotional states, having an inability to change emotional state at will, and blaming the actions of others for their own emotional state.