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Mind! Lessons from the Brain

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Grace was a young lady I saw professionally – I'm a psychiatric physician, a student of the mind. Grace was sensitive and wrote poetry. She struggled with negative emotions – horrible anxiety and deep sadness. Her thoughts were consumed by catastrophic worry, and that there was no hope because she was worthless. She avoided human interactions, rarely venturing out of her home. When she did, she wore long sleeves, even in the summer.

Grace had experiences she described as feeling she was disappearing – dissolving, being everywhere and nowhere. She found these frightening and wrote about them: Her words - "The confusion, pain and despair in my head swirls so fast, it becomes a maelstrom and I get lost. Nothing feels real anymore and if it lasts I feel I will be lost forever. My only salvation at these times is to cut the flesh of my left upper arm. The pain and the sight of blood are like throwing a rope to someone drowning in quicksand. It gives me something solid to hold on to - defining the boundaries of my body. It helps me know what is real and brings me back to that reality."

To make sense of Grace's experiences, and open a window into our own internal world, let's take a journey. We'll start with objective reality, the human brain. Just as what the heart does is it pumps blood, what the brain does is, it creates our mind. The mind is what we are conscious of. We'll journey internally, into the mind, our uniquely individual and private world. We'll examine what we already know – our mind is not a monolithic, consistent entity, constant as the Northern Star.

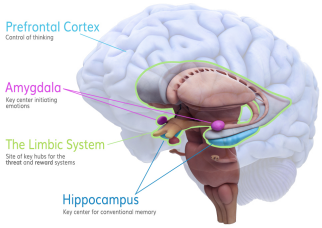
TWO MINDS

Intrinsic Mind

Emergent Mind

The postulate we will explore is that we are of two minds – an **intrinsic mind** that is derived from bottom-up processing in brain circuits, that functions in the here and now – resulting in sensations, emotions and passive thinking. Then there is this other mind - an **emergent mind**, derived from the networks in the outer layers of our brain. The emergent mind crafts a sense of self, and runs simulations in an internal, virtual reality. The emergent mind is what makes our species unique in the spectrum of life, allowing us humans, despite our puny physique, to have dominion. The fluid intermingling of our dual intrinsic and emergent minds happens seamlessly, creating a singular experience. When we lose the fluidity to shift between our two minds, we are in trouble, like Grace.

Yet, is that all that makes up our mind? We'll end with the ultimate mystery – consciousness. Ask a fundamental question - does our mind transcend the boundaries of our brain?



The human brain is arguably the most complex structure in the known universe. It is made up of estimated 100 billion neurons. Neurons are connected with each other through synapses – an estimated 100 trillion synapses – that's 1 followed by 14 zeroes. Imagine the bewildering complexity! Our brain functions in circuits – Gerry Edelman, a Nobel laureate, calculated the number of potential circuits in one human brain is larger than the number of particles in the known universe. Ladies and gentlemen, you are the proud owner of this astonishing organ!

The brain is a physical system bound by the laws of nature. What does our brain do? It computes data. It converts raw data into information. It does this by distinguishing patterns, providing order and context, and from higher order processing, derive knowledge, meaning and wisdom. The brain does this through circuits with feed-back and feed-forward loops, so data can flow in both directions. These happen in the micro to millisecond range – below the resolution of our conscious awareness. Computers also compute data, but they are limited by the narrow bands of their digital architecture. Brains, having life, order data with considerably greater dimensionality and complexity.

The gateway into our brain is through our senses. We are sentient beings. We have modules that compute each type of sensory information. Vision, for example, is our dominant sense. Our visual system converts light energy to chemical and electrical messages – the scientific term for that transformation is to transduce. Light energy is transduced into images on our retina, the equivalent of a photograph. But the photograph needs to be perceived. For perception to occur, the photograph is broken down into components such as brightness, color, edges, shape, texture, motion etc., and re-synthesized back together, so we can perceive the photograph.

This is important – because what the brain is doing is – it is mapping the data that has entered our brain. What we perceive in our mind is not reality, but a map of reality.

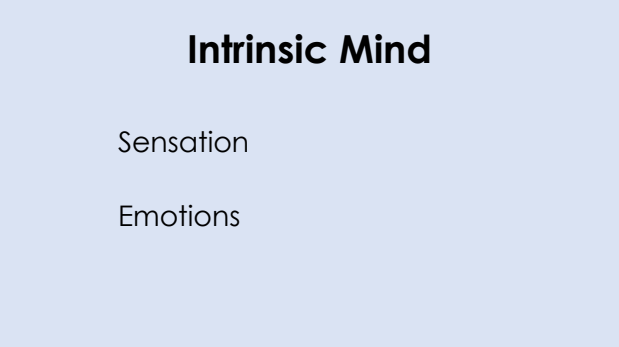
" The map is not the territory "

Alfred Korzybski, 1931

The Polish-American scientist and philosopher, Alfred Korzybski famously said: 'The map is not the territory'. If I am tracking my journey on a GPS map on my smartphone, and the battery dies, the map disappears, but that doesn't mean the reality of the road is destroyed. The map is only a reflection of its underlying reality.

Our mind is constructed based on brain maps. Fundamentally, those maps are a shadow of reality. What we call our mind, is not a physical entity, but derived from those shadows. The mind is a drama played in the maps created by our brain. Remarkably, what neuroscience is teaching us is that the Buddha and Plato were not wrong.

What are the implications of the map being only a reflection of reality, the mind as a constructed reality? Many people struggle with a gnawing suspicion that our mental life lacks a fundamental truth, that it is unsatisfactory - and search for a sacred truth, an absolute, authentic actuality.



Our brain computes data in hierarchical layers. We process sensory information, and then we react to it. The earliest response is triggered in an older part of the brain loosely termed the limbic system. The triggering is primarily through pattern recognition. There are two systems that can be triggered. One is necessary for species survival and set to recognize threat patterns. It is the basis of negative emotions such as anxiety, anger and sadness – those that Grace struggled with.

The other system recognizes rewarding situations and is the basis of positive emotions - pleasure and joy. Positive and negative emotions are primary emotions – they can be modified downstream, so we have the potential for numerous kinds of emotions. For example, threat in the social sphere is the basis of jealous feelings.

Let's look at some of the characteristics of emotions:

- Emotions are felt experiences, feelings framed by the vehicle of our body. Our sensory awareness is not just from the external world. We own a body. Its boundaries and the internal messages are also mapped in our brain. Emotions are framed by these somatic or body maps, which include visceral sensations from our gut, as well as chemical messages about the internal states of our body, such as from cytokines, or immune messengers.

  These give our emotions ownership – what we call agency. We are the agent experiencing them, giving us grounding, providing a stable context, a frame of reference, an embodiment, our personhood - the foundation of our multidimensional, sensory self. Because our body is framing emotions, if our body is sick, that's a threat - we are more likely to experience negative emotions.
- With repeated triggering, negative emotions become sensitized and grow. Thus, the swelling impact of trauma, particularly from abuse and neglect early in life. Repetition of positive experiences, on the other hand, are desensitized. For pleasure, we need novelty. If they are unexpected, the joy is multiplied.

- Emotions flow, like a river. What we are consciously aware of is just the surface – the big waves with whitecaps in a storm, or the mirroring stillness of serenity. Much of the flow is happening below the surface; flow can be smooth or turbulent. Turbulence is disorganized, messy, tangled and chaotic. There are eddies and whirls with backward flow. We can learn much about the distress from emotions by studying the dynamics of flow, in liquids and gases. Turbulence is mathematically non-linear, just like emotions and the distress they cause. We calm ourselves by reducing emotional turbulence, centering ourselves, breathing rhythmically, using our diaphragm.

Intrinsic Mind

Sensation

Emotions

Thinking

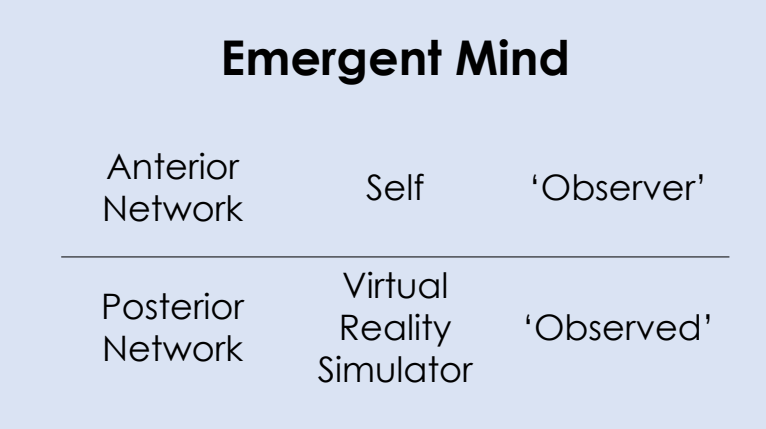
Cognition, or what we colloquially call thinking, is the result of higher order processing in the brain. Thinking is spatially organized. We have a set of neurons in a brain structure called the hippocampus, called place cells – place cells map our location geographically – birds use them for migration. Place cells orient us, providing spatial organization. The spatial grid becomes the foundation for organizing conventional memory and thinking. If emotions are fluid, then thoughts are solid ground. The mathematics underlying thoughts are more linear and algorithmic, providing a basis for proportion, sequencing in time, context, logic and reason.

Thinking can be passive if driven by bottom-up processing and controlled by emotions. Thus, anxious emotions make thoughts worrisome; sad feelings convince one is a failure. Grace's thinking – her worry and sad thoughts – were captive to her emotions of anxiety and sadness. Thinking were like wheels stuck in mud, spinning unproductively.

What we have covered so far, is the functioning of the intrinsic mind – from sensory mapping to emotions and thinking. These are passively and automatically processed. But in life, we make choices – what is the mechanism that allows our minds to choose? For that, we need the emergent mind.

The outer layer of the cortex functions as a network. Our cortical network is the basis of our emergent mind. We are most familiar with the internet as a network. In a network, nodes are connected with multiple other nodes. The number of connections between nodes is a measure of stability of the system. Few nodes and few connections make the system simple and rigid. More nodes and more connections between them, increases complexity. A greater ratio of connections to nodes increases the stability of the system and transitions are smoother. Few connections between nodes makes transitions abrupt and explosive.

We have multiple nodes in our cortex – for example, there's one for recognizing faces, one for numbers, for music, understanding speech, converting thought into speech, inhibiting our emotional centers, and so on. A group of nodes functioning together becomes a hub. On the web, we would consider, for example, Facebook or Google to be hubs.



There are two major hubs in the cortical network of our brain – an anterior one that is the basis of our sense of psychological self. The self is permeated with our biographical memories. This hub creates the perception of an 'observer' in our mind. A posterior centered hub, called the Default Mode Network, functions as the infrastructure for a virtual internal reality. Action here becomes the 'observed'. The self plays in this virtual space.

Past memories are recalled and played like movies. Future scenarios are run as simulations, so we can choose between alternatives and craft a strategic direction for our lives – get a degree from a leading institution, for example. Once a strategic goal is established, only tactical decisions need to be made to achieve that long-term goal.

Fantasies are creative constructions from desire. We can augment the experiences of the current moment, derived from the intrinsic mind – who among us has not enhanced pleasurable moments with fantasy?

TWO MINDS

Intrinsic Mind

Emergent Mind

Our mind, is a flowing mix of our intrinsic and emergent minds. Both bottom up processing of sensation, emotions and thought, overlaid by top-down processing that personifies our choices with agency and infinite potential simulations. The universe of our mental life can soar beyond the boundaries of our objective reality.

Let's return to Grace's experience where she was disappearing into a sense of nothingness, being nowhere and everywhere. Is there a brain-based explanation for such a dissociative experience? Breaking it down, Grace loses components of her sensory processing, the basis of her sentient being and her sense of self. We started out by defining the mind as what we are conscious of. Grace was still conscious – so sensory perceptions contribute but are not sufficient for consciousness.

If there is consciousness beyond the sensory foundations of mental life, what is it? It raises fundamental questions: is consciousness derived completely from brain processes, or is consciousness external to the brain, that the human mind can touch in awareness? If there is consciousness outside of the brain constructed mind, what is its nature, and what laws does it follow? There is no consensus on these issues, so the questions are left hanging.

It is interesting that Grace's experience of nothingness, is similar to the emptiness monastics in various traditions and deep meditators spend years training to achieve - the loss of sensory grounding that is the basis of the perceived self. What is mental experience without a sentient basis? Science is now exploring these issues - from theoretical physicists exploring dimensions beyond the manifest dimensions of space and time, the relationship of dark matter and dark energy to a universal consciousness, consciousness as a mathematical object, or a higher order of synchrony and entropy. Should we gracefully accept that we may never know?

Thank you.