THE EMERGENCE OF THE DEFAULT MODE NETWORK AS THE MOST IMPORTANT NEURAL NETWORK FOR GLOBAL BRAIN FUNCTIONING

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The array of emotional, social, cognitive and purposeful functions that support, reinforce and enrich our experiences require specific designed patterns of collaboration between network brain regions and their interregional relationships.

The human brain comprises over 100 billion neurons, each of which, on average, is connected to about 10,000 other neurons and possesses a computational capacity that far exceeds even the most powerful supercomputers. The human mind capacity is enabled by the neuron's ability to organize themselves into coherent combinations or partnerships, if you will, arranged in precise sequential patterns.

What makes each brain so unique is the ability to create, adapt, connect and disconnect networks in a manner to allow for efficient communication within and between neurons, something that we refer to as connectivity. The anatomical framework underlying connectivity has been the subject of numerous excellent reviews. There appears to be a dynamic reorganization that is a key property of functional brain networks. (Buckholtz, Meyer-Lindenberg, June 21, 2012).

We now know that these brain networks adapt and reconfigure themselves in response to external stimulus or a change in a psychological state

As most people know, the brain is composed of two hemispheres that have interconnected but have very different functions. Neuroscience technologies and research have provided us with a more complete picture of the left and right hemisphere's specialized roles. The left hemisphere tends to control many aspects of language and logic and is the primary source of neural information that a person uses to carry out routine tasks, science and mathematics. The right deals with novelty, creativity, more "poetic" in nature.

Brain networks comprise the standard operating procedures that we use throughout any given day- a cognitive library that automatically activates to handle familiar tasks and challenges. Neuroscientists such as Elkhonon Goldberg calls the constellations of neurons in the left hemisphere as "attractors". They are supportive of the role played by that hemisphere. They are organized to orchestrate thought and action with great efficiency and effectiveness.

They form the basis of what Herbert Simon referred to as pattern recognition, which he considered the most powerful cognitive tool we have. Simon defined pattern recognition as the brain's ability to scan the environment; discern order and create meaning from large amount of data; and thereby quickly assess a situation so that appropriate action can be taken right away and with a high degree of accuracy. The power of pattern recognition, a critical competence of executive brain, can be seen in the capacity to simplify without being simplistic. (Waytz, A, Mason, M, "Your Brain at Work", Harvard Business Review, July-August 2013). It is here where we see the emergence of neural networks and how networks of brain regions activate in concurrent, synchronized patterns. Patterns such as; how to enable creative thinking, how to structure rewards, the role of emotion in decision-making and the athlete attainment of being in the "zone" can be understood. Brain scientists have now identified as many as 15 brain networks and subnetworks.

A recent book written by the well-known neuroscientist and pioneer in research into novelty and routine in the brain, Dr. Elkhonon Goldberg, entitled, "How does the Brain deal with novel situations, creativity, complex decision making, suggests that there are three core neural networks most often involved in brain research: default mode network (DMN), the central executive network (CEN) and salience network (SN). Goldberg states that these three networks are the "richest" of the "rich club" networks, which is to say the three highest level networks in the brain that control global adaptive functioning. We will explore the DMN network in this article.

We all know that the ability to focus plays an important role in the area of excellence. To-do lists, calendar reminders, alarms and timetables all help us to stay on task. According to recent research, both focus and unfocus are vital. Research indicates, that we spend 46.9% of our days with our minds wandering away from a task at hand. According to Goldberg, the brain operates optimally when it toggles between focus and unfocused, allowing one to develop resilience, enhance creativity, and make better decisions. We need to support the ability to have self-regulation and effective decision-making capabilities, and to protect ourselves from toxic stress. We need body awareness, pain tolerance, emotional regulation, introspection, focus and concentration along with complex thinking and a sense of self.

Current research has now shown that the brain is never truly at rest. During wakeful periods, when our brain is not focused on anything in particular or any specific goal, when our mind is wondering, or we are just plain "zoning out", a distinct network of functionally interconnected brain regions still fired up. It is called the "default mode network" or DMN. The interest in this network is fairly recent. Research indicates that complex mental functions arise not only from isolated brain regions but from interactions among multiple interconnected distributed networks of regions; and that, activation patterns in a brain at rest are every bit as interesting as the activation patterns in a brain engaged in a cognitive task (Goldberg, The Human Brain in the Age of innovation, 2018).

We used to think of this circuit as the "do mostly nothing" circuit because it came on only when you made an effort to focus. Yet, while at rest, this circuit uses 20% of the body's energy (compared with the comparatively small 5% that any effort will require). The DMN needs this energy because it is doing anything but resting. It is activating old memories, going back and forth between past, present and the future; and, recombining different ideas and one's relationships to others. It is argued that it is during these states that the most important, consequential problems are confronted, and decisions are made by an individual.

The DMN network allows for novelty, the ability to find solutions for problems not tackled before, the ability to relate old knowledge to new problems- recognizing familiar patterns in new and unique problems. The ability to generate multiple and diverse approaches to a problem which is essential to the creative process in science. With this data available to us, we develop enhanced self-awareness and a sense of personal relevance. We can imagine creative solutions or predict the future, which may lead to better decision making. It also helps with tuning in to other people's thinking, thereby, improving understanding and cohesion.

Familiarity with how our brains work can give us a much-needed edge in our daily life and can boost focus, productivity, creativity and efficiency, critical thinking and the ability to make better informed decisions.

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