UNLOCKING CONSCIOUSNESS

BRIAN MIND FORUM

Appendix 025

EMERGENCE

'The whole is greater than the sum of the constituent parts'.

(Plus a note on 'Silent Speech')

One of the most powerful concepts in Cognition is 'emergence'. Scientists argue that out of all the mass of neurons, attributes like 'consciousness' *emerge*. This almost seems to be a catch-all excuse when we have no greater knowledge. However, there is a strong argument for the principle, and, indeed, it is the foundation of the architecture of almost all computer programs, and a great deal of cognition.

The Computer Perspective

In designing a computer system, we set out all the inputs, outputs, processing and objectives, but no one then starts at the beginning and writes one long program to encompass the whole specification in one long narrative. Even if one did it would be near impossible to find, let alone correct any errors and make amendments. All programs are broken down into a hierarchy of sub units. Each function can then be programmed independently, and a library of functions established. Each can be rigorously tested, then groups of sub units can be linked together until major components can be organised to complete the whole task. Programmers call these sub units '*subroutines*'. It is one of the most powerful concepts in computing.

Thus, from a whole series of tiny steps, insignificant on their own, we can, for instance, create a system that can win chess games, or manage on line in real time many thousands of aircraft in an air traffic control system.

'Emergence' is based on the argument that '*the whole can be greater than the sum of the constituent parts'*. Look on a building site. In one corner, there is heap of bricks and tiles, in another lengths of wood, some pipes, bags of cement and plaster. Nothing very impressive, yet in skilled hands not only can a house be built, but a home can be created, in which a

whole family may be born and brought up. It may be a heap of bricks from one point of view, but it may well have a very powerful influence on how a succession of people live their lives. St Pancras railway terminal building in London is one of the most imposing examples of the self-confidence of the industrial revolution, yet it is only made of bricks, stone, wood and so forth.

The Language Perspective

At a simpler level, it is the concept on which the whole of language is built. We have noted elsewhere that it seems likely that the first words were a form of label that enabled people to identify things to each other. For instance, the word 'tree' by general agreement represented all the large plants with trunks, branches, and a mass of leaves and roots. The word 'run' referred to moving as fast as possible. We passed on these words through the generations because they were convenient and because when we heard the word tree we had a mental image, a sensation, of a tree, and our brains activated all our experiences to do with trees; climbing them, hiding in them, picking their fruit, using them for fuel. We linked the word with the visual images, sound, touch, taste and smell of 'trees'. Thus, we build a whole raft of associated information that gives the word 'tree' *meaning* to us. We could give someone who had never seen a tree a very reasonable impression of what a tree was like by reference to all its attributes.

So far so good. However, if we put two words together, say, 'flowering tree' then we immediately know far more than just the addition of those two words together. We effectively have a new entity, and, crucially, this new entity has more information, more value than the two words separately.

The Emergence of Meaning

As we grow our individual personal dictionaries, so we grow neural representations of those words, but we do more. We link every word to a pattern of neural activity that activates the muscles of the throat and mouth to speak that word. We activate the muscles of the hand and fingers to write that word. We also activate the appropriate glands to secrete hormones – neurotransmitters that give us a sensation, impression, feeling of that word – a small unit of emotion generated by that word. That word begins to have '*meaning*' for us.

That 'meaning' becomes much stronger according to how many other words are associated – where the stimulation of the neural patterns for that word activates cross references and associations, each of which in turn stimulates further glandular activity. Thus, say, ten relationships generate a hundredfold increase in the 'meaning' of the original word when incorporated into phrases.

Thus, every word has a neural footprint. We explore the constituent parts of words, like spelling, phonemes and syllables elsewhere. Here we are concerned about the upwards links to phrases, sentences, paragraphs, essays and books. Some obscure words may be associated with a small number of links and so are only part of a few footprints. Some words are associated with an almost infinite number of other footprints and hierarches of mega footprints. The neural stimulations of glandular

secretions for one word may be microscopic but in mega footprints they can be very powerful indeed.

Even more powerful is the patterns in which words are associated. Sequence can have a dynamic effect and can change the meaning of one word, or all the words nearby.

For example: reading the following list of sixty nine words does not arouse much interest. Individual words can be quite 'emotive' but not significantly so in this context.

"Aloud am and (3) as be beyond black bloody bludgeonings but (2) Captain chance charged circumstance clutch covers cried Fate fell find finds for from gate gods have head horror how (2) I (4) in is it looms master matters me (2) menace my (3) night nor not (2) of (5) out pit pole (2) place punishments scroll shade shall soul (2) strait the (11) tears thank that there this to years yet winced with whatever wrath unafraid unconquerable unbow'd under."

In fact, this list of words is quite difficult to read.

Now rearrange that identical list of words in this pattern, and we have one of the most inspiring poems in English literature: that every British teenager should be able to recite before they leave school.

Out of the night that covers me,
Black as the pit from pole to pole,
I thank whatever gods may be
For my unconquerable soul.

In the fell clutch of circumstance
I have not winced nor cried aloud,
Under the bludgeonings of chance
My head is bloody, but unbow'd.

Beyond this place of wrath and tears
Looms but the Horror of the shade,
And yet the menace of the years
Finds, and shall find me, unafraid.

It matters not how strait the gate,
How charged with punishments the scroll,
I am the master of my fate:
I am the captain of my soul.

Invictus: W. E. Henley

The emotional effect is enormous. Even died in the wool, mathematicians, are rarely unimpressed!

The volume of neurotransmitters generated just reading the alphabetical list is minimal. The volume of neurotransmitters progressively generated from the same words but in this sequence is substantial. Orders of magnitude more substantial.

The whole is demonstrably far greater than the sum of the parts.

We can learn a very great deal from this concept of emergence. In computing, this poem might be repeated in various files in a word processor. Certainly, the constituent words will be. On the last line 'captain' and 'soul' are likely to have been used in a multitude of contexts over a lifetime. In the memory banks of word processors copies may well appear hundreds, if not thousands of times.

The Cognitive Neuroscience Perspective

That is the opposite case in the brain mind. It is almost certain those words will be stored just once, but with links to all the other words with which they have been associated. Thus a word like 'captain' can often have a number of sub meanings: captain of a ship, leader of a group, controller of events…..and be linked to all the people we know who have that title….

Thus to recite 'Invictus' does not involve learning the words, because we already know them. Learning poetry, or a speech, or a part in a play, involves learning to assemble the words in the correct sequence. We do this by growing a neural 'circuit' that links the word footprints in the right sequence. When we learn to recite 'Invictus' we have not learned the words, we have learned the sequence in which they occur. When we recite Invictus we just activate that circuit, which stimulates each word in sequence, and influences the emphasis we place on its enunciation. Invictus in our brain mind is a pattern of patterns. Also, without effort we can redirect that neural stream to our hands and fingers to write the words! Reciprocally, there is a 'note' attached to the footprint of each word that it has been used in the Invictus pattern, and when we recited it, wrote it, thought it, and who was there, and the reactions……

As soon as we began to understand the way neurons worked, researches began to think about how clusters of neurons might work together to deliver ever more complex functions.

Donald Hebb (see Appendices 10 and 12) described these concentrations of neurons working together as *'cell assemblies'*, and described hierarchies of these assemblies, phase sequences, pathways and gradients and suggested the word *'engram'* to describe them. When we analysed the formation and structure of memory we described these as neural modules and coined the composite word *'neurules'*. Arthur Koestler suggested *'holons'*, and Richard Dawkins has promoted *'memes'*, among some dozen other suggestions. Recently research at the University of California at Dan Diego on the source and effect of brain waves (Appendix 16) has suggested this may be part of the way in which large groups of neurons combine together in what they describe as *'spacial maps'*. They have chosen to call these *'cooperative groups'* by the term *'functional assemblies'*.

Emergence of the Process of Thought

Silent Speech

There is more to discover.

One of the conundrums of cognitive neuroscience is the phenomenon of 'silent speech'. We talk without speaking: we hear without a sound being uttered. It seems to be a relatively minor issue, but it just might be one of the keys to help solve many of the deep problems of thinking, and even consciousness.

The cognitive design engineers have already stumped the neuroscientists by raising the conundrum of how neurons switch streams of words either to the vocal chords to speak, or the fingers to write. In all conventional thinking neurons either fire or do not fire. There is no known facility to switch the output between alternatives. How do we select a third alternative?

Is there be a third alternatives? To output 'speech' via a 'bypass' direct to the hearing systems? It is a bit cumbersome and nature usually evolves elegant solutions.

What if the solution is that a stream of words stimulates a pattern of neurotransmission activity which we experience as meaning, but which is powerful and accurate enough to activate the hearing system from the inside, as it were- initiated in the brain mind; rather than the outside – from the ears and hearing system?

Thus ideas, concepts, phrases are composed and only then are they directed to the writing, speaking or thinking systems. All language begins its processing as a purely neural activity. There is evidence for this conjecture.When children learn to read they start by speaking the words as they see them. Only when they are proficient do they read silently. Similarly, as we write, or key sentences we speak them in our heads to guide our fingers.

Silent Reading Is Quite Recent Skill.

There is some evidence that adults only learned to read silently about the fourth century. Augustine of Hippo remarks that he may amazed to see Ambrose, Bishop of Milan reading without speaking.

Thus, we can begin to see how we can unravel the conundrum of thinking. We can think anywhere, anytime, entirely within our own heads. We do not require, pen and paper, or even light. Only when we have created some thought, simple or complex, do we need to conceptually look out to the world and communicate with whoever is around in whatever way seems appropriate.

So perhaps the concept of emergence is one of the key building blocks of being a sentient human being.

We can ask another question. If a group of words or neurule of neurons can generate such a powerful and detailed emotional response in the form of patterns of hormones and neurotransmitters, is it possible that this process could operate reciprocally? Can a powerful pattern of emotions stimulate electrochemical signals in patterns of neurons to speak one or a sequence of words: to write one or a sequence of words,

or to hear one or a sequence of words without either speaking, hearing, or reading them?

If so, we are on the right track to understand how new concepts and activities and how we think are created. A breakthrough indeed.

Another example of the Emergent power of poetry is Vita Lampada, beloved of the public schools and the Army. The thirty eight words of the second verse are:-

a 3, and 5; banks, broke blind, brimmed, but; colonel's; dead, death, desert, dust; England's; far, game, Gatling's; has, his, honour; jammed; name; of 4; play 3; rallies, ranks, red 2, regiment, river, sand, schoolboy, smoke, square; that the 10; up 2voice; with 2, wreck.

Vita Lampada

There's a breathless hush in the Close to-night –
Ten to make and the match to win –
A bumping pitch and blinding light,
An hour to play and the last man in. And it's not for the sake of a ribboned coat,
Or the selfish hope of a season's fame,
But his Captain's hand on his shoulder smote –
'Play up! Play up! And play the game!'

The Sand of the desert is running red,
Red with the wreck of a square that broke;
The Gatling's jammed and the Colonel dead,
And the regiment blind with dust and smoke.
The river of death has brimmed his banks,
And England's far, and Honour a name,
But the voice of a schoolboy rallies the ranks:
'Play up! Play up! And play the game!'

Henry Newbolt.

Vita Lampada celebrates the Battle of Abu Klea, fought by the Gordon Relief Expedition in Egypt, on the 17th January 1885.
Fought by the 176 Field Battery, Royal Artillery, who closed the broken square.
The 176 Field Battery was awarded '*Abu Klea*' as a Battle Honour in 1955, while serving in the 45th Field Regiment, Second (Infantry) Division, British Army of the Rhine.