UNLOCKING
CONSCIOUSNESS

BRIAN MIND FORUM

Appendix 043

How inanimate chemicals process information

The concept of a 'system' is another one that is used widely in reference to both biological processes and computers. Perhaps we need to explore some of the attributes of a system and how they apply to our discussion of the brain.

The first important aspect of the system we call the brain is that it is driven entirely from within. All our machines are externally organised; they are limited by their program and the information input to them. Our brain, like everything else in Nature, is self organising. Once it has been set up – that is, once we are born – this whole intricate system completely manages and operates itself.

How can a mere bunch of chemicals organise anything? How can inert materials, even if they are organised as living tissue, carry out processes that we recognise as intelligence?

Perhaps we can begin to understand how this is possible by means of an analogy.

If we have a level tray of sand and we drop some metal balls onto it they will stay where they fall. If we drop them in a pattern that we recognise as the letter 'A' they will stay like that. If someone else comes along and sees the tray they will recognise the 'A'. That is how externally organised systems work. Neither the tray, nor the balls have any involvement in what is happening, nor do they make any active contribution. They are quite inert. We have determined the tray, the balls, how they are placed, the coding system that represents an 'A', and we have defined what an 'A' means to the reader.

If we stretch a thin plastic sheet over a large bowl of water and drop our ball on to the surface it will create a small crater. If we drop a second ball fairly close, it will roll down into the crater, and make it deeper. After a number of balls have been dropped in the same general vicinity, the weight of balls in the crater will create a hole and most of the balls will fall through and splash into the water, leaving behind a shallow crater and a small hole. For the purposes of our analogy, even in this very simplistic example many new ideas appear.

The first is that the plastic sheet has actively responded to the information it has received. The tray of sand did not change but our plastic sheet changes its behaviour, entirely and solely on the information it has received. The first few balls produce little effect but eventually they cumulatively cause a hole in a particular place. Now every time a ball falls in this general area it falls through that hole, causing a splash in the same place. In the crudest possible way, the plastic sheet has developed a response to balls falling in a particular area. After a number of occasions, we might associate that splash with a sound, which we might label 'A'. Thus, this system 'learns' that the arrival of a certain stream of 'information' relates to the sound 'A'.

The tray of sand was inert. The plastic sheet is only chemicals in a different structure, but it has properties that enable it to respond to a simple process. It can organise itself to 'recognise' a ball and enable it to drop though a hole, causing a splash in a consistent position.

But our system can go further. The incoming stream of information does not have to be exactly the same every time. In the sand example, if all the balls are slightly out of place the image may become unrecognisable. In the plastic sheet model, small discrepancies will not affect the balls deepening the crater and in due course falling through.

If the odd ball is way out this might delay the reaction - recognition - but will not prevent it. The more frequently this image is recognised, the larger will grow the hole and so recognition will get quicker. So, the more the 'memory' of the image is used the more efficient it will become.

This does not exhaust the advantages of this system. Let us imagine a much bigger plastic sheet. This enlarged plastic sheet could develop numbers of craters in various positions associated with a set of distinct splashes that represent, say, the alphabet and numbers. Even if the incoming information is unclear, i.e. lands between either an '8' or a 'B', as the balls fall they must immediately roll into one crater or another. Thus, the system discriminates quickly and 'selects' which character it is. In fact, it makes a decision. It makes that decision based exclusively on the quality of the incoming information combined with its accumulated previous experience - nothing else.

Our imaginary plastic sheet can, to a limited extent, categorise and so be said to recognise incoming information based upon experience. It can learn – it can make decisions. These are the basic attributes of what we call intelligence.

If we begin to relate our analogy to the brain, the stream of information coming in could be signals from the eye looking at a printed image. The splash represents the brain stimulating the muscles of the vocal cords to generate a sound that repetition and experience has shown will satisfy and please the outside world when associated with that image.

Obviously, our neurons are not in any way like a plastic sheet, but as in our analogy, evidence suggests that the 'learning' process in our brain operates in two halves: a matching process, which is heavily dependent on our previous experience, is followed by the implications of recognition.

Incoming messages from our senses are organised into the same format that created the initial memory, enabling the brain to recognise them. There is also a feedback mechanism to avoid gross errors and prepare the system for what experience has shown is likely to follow. We see this clearly in the way that we understand the meaning of some words differently, according to the words that precede and follow them; in other words, according to their context.

As well as being self-organising, our brain is an 'enabling' system. As early as the first few weeks after conception, a symbiosis develops between the cells that create the heart and the cells that create the nascent brain in the foetus. The heart pumps fuel and the brain stimulates, controls and monitors the heart's pumping action. These first electrical impulses are the foundation of all neural activity. From birth and throughout our lives, a section of the neural system manages certain vital functions in our bodies. We call this the autonomic system, which keeps the heart, lungs and other critical organs functioning irrespective of our state of consciousness.

Extract from Biological Systems of the Brain. Redpath & Ross 2008.

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