

Consciousness

One anesthesiologist's take on it.

Mark Elliott, MD, FRCPC

Anesthesiologists take consciousness away from a patient before a surgical procedure and then bring consciousness back to the patient after the operation is finished. Consciousness has been an important topic in religion and philosophy for millennia, but with neuroscience progressing the way it is, it is becoming an important topic in science as well. The main problem is that consciousness is qualitative but science is quantitative. It was Galileo who first made science totally quantitative when he started rolling balls down an inclined plane and found that the distance rolled was related to the square of the time taken. Science has been on a roll ever since.

I am going to take the point of view that, in principle, neuroscience should eventually be able to figure out quantitatively what qualitative consciousness is. The progress in neuroscience on this subject has been startling over the past few decades; however, as the metaphor states, we are at the stage of listening for a heartbeat with a stethoscope on an acorn.

On the opposite side of this empiric bias is the point of view that consciousness will never be explained unless there is some supernatural force present to explain the mystery. This implies that the fundamental building blocks of reality are conscious, which usually leads to all sorts of ethereal terms like panpsychism (everything is conscious). There is some scientific truth to this. Richard Feynman used to wonder if an electron had its own mind. There is a mathematical proof of something very similar by Conway and Kochen, who basically say that if we (humans) have free will to choose to measure

Dr Elliott is a staff anesthesiologist at Providence Healthcare in Vancouver.

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something, which basically means our decisions are not based completely on the past (a real deterministic universe) then the particles must also have free will.

What

We can talk about *level* of consciousness and *content* of consciousness—the functional aspects of consciousness that most would say arise in patients' brains—but then there is the “hard” problem of consciousness.

Anesthesiologists are experts on the level of consciousness. Basically we know what depth of anesthesia (level of consciousness) we need to take patients to without killing them. Anesthesiologists don't know much about the content of consciousness. We don't know what a patient's inner voice is saying. We can guess, but we can never know for certain. Humans pick up this trait of being able to guess what another person is thinking at about 5 months of age, according to child psychology. But what about dreams? In a certain sense a patient is conscious when dreaming.

The hard problem is understanding what it feels like to be conscious. The defining essay,

written in 1972, was entitled, “What is it like to be a bat?”¹ Many argue that no matter how much we discover in neuroscience we will never understand a bat's inner feelings. There is a bit of a linguistic debate here, and some say *experience* is a better word than *understand*.

Discussion such as this usually leads to the mind/body/brain problem. Again this is an old problem dating back at least to Plato with billions if not trillions of words written about it. But in essence there are only three ways to think about it. One, your mind and body/brain are the same thing; when you die, your mind and body/brains dies. This is what the ancient Greeks thought. The second is the scientific way, first outlined by René Descartes, that your mind, which he called *res cogitans*, or thinking stuff, acts like an operating system on your desktop controlling the body/brain stuff, which he called *res extensa*, from the pineal gland, which was the only unpaired homunculus in the brain. The theory did not pan out. The third is the religious way of thinking about it, which started long before the other two ways, and says floating somewhere above your body/brain is your mind or soul and, that the soul never really dies.

To sum up, consciousness is either the most mysterious thing in the universe or the most not-mysterious.

When

I ask the reader to consider the following children's story about evolution. Billions of years ago, a small single-cell organism (let's call him Mark) is floating in a black unoxidized sea veneered on Earth's surface, randomly bumping into smaller things it can ingest to basically stay alive and reproduce. Bigger things eat Mark. I doubt Mark is conscious.

Over a few million generations Mark develops the ability to move by a small flagellum or some other type of propeller in water. Now he can move toward food and away from danger. I doubt Mark is conscious.

Millions more generations later Mark is a small worm with the ability to eat and then hide somewhere safe to digest. Conscious? I don't know.

A few million more generations go by and Mark has eyes and sticks his head out of the sea. In the black ocean he can see (*sense* is a better word) not even a millimetre in front of him and has to immediately react to the environment (a predator) or else be eaten. In the atmosphere there is now much less photon attenuation and Mark can see for perhaps a kilometre. There is now a time delay between the seeing and the need to act (to get something to eat). Mark is now aware of this. And conscious?

Millions more generations of evolution go by and now Mark has a brain big enough to give him an internal representation of what he sees so he can plan what to do in order to eat. He now has what the psychologists call object permanence (he knows something is there even when he closes his eye). Mark is probably conscious.

Because this development has been so successful at eating, there are now millions of Marks. They have a sound-based language and are able to cooperate, construct hypotheses, test things with experiments, and make the world a better place for all the Marks. All this neocortical functionality was driven by the need to cooperate with the other Marks. By definition this means selling something. In other words, there was probably more than a little deception

going on. To paraphrase evolutionary biologist Robert Trivers, it is more than ironic that deception and its propagation were the files against which the tools of neocortical brain development were sharpened.² These Marks are probably conscious.

The Marks develop a science that shows them that the ratio of brain to body weight compared with time spent in infancy is a very curious thing. At the lower end of this scale is the chicken. Shortly after birth, perhaps within a few months, the chicken is an adult and starts laying eggs. A little up the scale are crows, who are given worms by their mother for perhaps the first year or two of life. They are smart enough to be trained to clean up garbage in a stadium after a football game. Then you have humans, who keep giving worms to their kids for a long time (some argue this lasts until the parents die). They are conscious.

Where

The underlying model of the brain in neurology is called the deficit lesion model, dating back over 100 years (which should scare you) to people like Paul Broca and Carl Wernicke with their aphasia diagnosis.³ A neurologist would still use this model today in assessing a stroke. This model was a good heuristic in the past but it is hopelessly underspecified in today's neuroscience.

Consider a patient with a hemispatial neglect syndrome from a right-sided cerebrovascular accident. Nothing in the left visual field is processed, so when a patient is looking at a picture of a house that is burning in the left wing, it will look identical to one that is not burning, but the patient *knows* you should leave this house if shown a picture of it. The patient seems to be processing information but not experiencing processing the information.

Consciousness is not localized; it is widely distributed, at least in the brain. Panpsychists say it is distributed throughout the whole universe. Research on things like this leads people to say that consciousness is simply the imperfect perceptions of the brain making an imperfect model of itself and the outside world. But speaking from an evolutionary point of view, perception is not about seeing reality as it really is: it is about having kids.

There are about 100 billion neurons in a human brain; 70 billion are in the cerebellum. The cells here seem to very linearly connected. Patients can lose their cerebellum and still be totally conscious (although they will have real issues with movement). Ten billion neurons are in the lower brain, leaving about 20 billion for the neocortex, where all the action is, from a consciousness point of view. This has led to the belief that consciousness is due more to the connections between neurons—the connectome.

How

There is an anesthetic explanation for *how* first put forth by Stuart Hameroff. It is based on microtubules—the scaffolding inside each cell. They are like tubes of the scaffolding on the outside of leaky condos, only in this case the walls of the tubes are made with peanut-shaped bipolar proteins called tubulin that are a helix, somewhat like the DNA molecule. A nice round cell like a hepatocyte doesn't need too much scaffolding to maintain its shape, but a neuron with its thousands of dendrites and an axon extending out millions of times the diameter of the neuron cell body needs lots of scaffolding to maintain this far-from-equilibrium shape. The thinking is that somehow the computation of the brain goes on here. This idea was given much credence when one of the world's foremost mathematicians, Roger Penrose, teamed up with Hameroff.⁴

Why

This is where the rubber hits the spiritual road. Some argue that why questions are best left to the philosophers, whose arguments never seem to converge the way that science tends to.

But the next time you are in an operating room with patients being put to sleep and waking up, you might ask yourself where they went. ■

References

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