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The Ancient Origins of Consciousness by Todd Feinberg and Jon Mallatt review – how the brain created experience

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As brains become more complex so sensory consciousness becomes enriched. Photograph: Sebastian Kaulitzki/Alamy

What does it mean to say that I am conscious? For sure, consciousness is a protean term, with multiple meanings. Among its features are some or all of the following: trivially, that I am awake and not asleep or "unconscious"; more positively that I am aware of my surroundings, experiencing and responding to the sensory web of vision, sound, scent that bombards my every moment, that I can relate present sensations to past experience, remember

the past, anticipate and plan for the future, that I can decide upon a course of action, or the form and words of the sentence I am writing. All these sensations, memories, plans and anticipations of action occur within the private, subjective world encompassed by the at once familiar and mysterious words "I" and "me". "I" is a self, with a mind, an internal subjectivity and a permeable boundary to the external social and physical world. Humans are social animals, and our consciousness is profoundly part of, shaped by and necessary for, our existence as social beings.

Once upon a time, worrying about the mind and consciousness was the job of philosophers and theologians. Tranquil introspection was the method, as when in the fifth century St Augustine asked how it was that the mind could encompass vast regions of space and time, imaginary as well as real objects, or the idea of God. Eleven hundred years later, by which time, at least in western philosophy, minds and consciousness had become indissolubly linked to the brain, Descartes famously believed he had solved the problem by separating mind/soul from body as two separate worlds, interacting through a portal in the brain's pineal gland. Souls were given by God and unique to humans; the remainder of the living world was mere mechanism. Such a dualistic solution could not survive the onward materialist march of the physical and biological sciences, which seek to unify the world within an overarching framework in which everything is ultimately explicable in terms of the properties of the fundamental particles and forces that constitute the universe.

If dualism is rejected, consciousness becomes a problem for materialists, faced with the paradox of explaining how an apparently immaterial phenomenon could emerge from the all-too-material 1.5kg of nerve cells and their connections that comprise the human brain. The gap between what an outside observer can perceive and the subjective experience of the conscious individual – the so called "hard problem" – seemed unbridgeable. Despite the confident pronouncements of 19th-century physiologists, who claimed that brains secrete thought like kidneys secrete urine, their sloganising was more like whistling in the dark than a coherent research programme. Even a few years ago, consciousness was out of bounds for neuroscientists – to study it was, as one young researcher put it, a Career Limiting Move, suitable only for those retired scientists entering their end of life philosopause.

No longer. The onward march of neuroscience has finally reached what it sees as its last frontier. Neuroscience has become an integral component of the new field of "consciousness studies" complete with the necessary academic apparatus of journals, conferences and teaching programmes. With what they call a ruthless reductionism, some seek to solve the consciousness problem by abolishing it, denying its existence, as a "user-illusion". You may think you are a conscious being responding to and acting upon the world, but really your brain is doing all the

work, and you could as well be a zombie – though it seems unlikely that the consciousness theorists who hold such views think that they themselves are zombies, or why would they bother trying to persuade others? Did DNA pioneer Francis Crick think that he was, as he wrote, "nothing but a pack of neurons" without free will, even as he went on to identify a particular brain region, the anterior cingulate sulcus, activated when a person is trying to solve complex problems, as the site in his brain responsible for just that sensation of free will?

Less ruthless reductionists dismiss the view that being conscious is an illusion, and instead recognise it as an emergent property resulting from the organisation of the hundred billion nerve cells and hundred trillion connections between them that constitute the human brain, a property that cannot be reduced to its parts any more than the wetness of water can be reduced to the hydrogen and oxygen of which it is composed. However many go on to insist that such consciousness has no function, a mere epiphenomenon, the whistle to the steam train while the real work goes on in the engine room. (In which case of course, if a computer system of this degree of complexity and interconnectedness could be constructed, it too would be conscious, though what form such consciousness might take is hard to imagine.)

This has always seemed to me improbable. A mere glance at the list of attributes subsumed within the very word consciousness implies functionality. Being conscious is so evidently crucial to our ability to survive as social beings. But is such consciousness unique to humans? And if not, then when did it emerge in the long path that preceded the appearance on Earth of Homo sapiens? For me, as for psychiatrist Todd Feinberg and evolutionary biologist Jon Mallatt, consciousness, like every other aspect of being human, is a product of evolutionary change powered by natural selection. *The Ancient Origins of Consciousness* undertakes the task of tracing this route, from the earliest appearance of life onward – an approach its authors call neuroevolutionary.

Feinberg and Mallatt argue that the seeds of consciousness lie in the very origins of life on Earth, more than 3bn years ago. Not of course the rich subjectivity with which the word is imbued today, but what they call sensory consciousness, the ability to respond to and act on the external environment, as when their present-day successors – single-celled animals such as amoeba – detect and navigate towards food sources and withdraw from noxious ones. Even such single-celled creatures behave as if they have a sense of bodily integrity, their membranes studded with molecular receptors which can recognise the difference between themselves and something that is not-self. This is where the authors' neuroevolutionary path to human consciousness begins.

For single-cell organisms, the path from sensory input to motor response is direct and unmediated. For multicellular creatures things get more difficult; sense

inputs must be able to signal to distant motor organs – originally through molecules chemically similar to today's hormones. But nervous systems are faster and more specific, providing a direct private line between the two. Feinberg and Mallatt draw on fossil evidence and the nervous systems and behaviours of the present-day successors to these long-extinct creatures to document this evolutionary history. For them, the crucial moment comes with the emergence of brains, which group together what was previously a diffuse nervous system into a tight cluster of nerve cells and their connections; no longer are sensory inputs and motor outputs directly linked but are separated by several "hidden layers" of nerve cells, making possible vastly richer possibilities of interconnection and the storage and recall of experience – learning and memory. These clusters are the precursors to modern brains.

They date this transition to the great Cambrian explosion of novel life forms that occurred about 550m years ago. Before then, animals were essentially vegetarian, grazing on the great oceanic beds of algae. The new life forms of the Cambrian included predatory carnivores. Hunting for food required new skills and sharper senses, and vegetarians needed new defence mechanisms. An evolutionary arms race drove the search for bigger and better brains, enhanced senses and faster motor coordination and responses. After much hesitation, the authors settle on the lamprey as the poster-organism for this key step. Lampreys? Eel-like creatures that live by biting into their prey and sucking out their blood. Bishop Wilberforce, who when confronted with Darwin's evolutionary theory so famously objected to being descended from a monkey, would have been appalled at the thought that all his high flown theological rhetoric had such humble evolutionary origins. Brains and consciousness did not evolve to create theologies, but as enhanced survival strategies in an unforgiving world.

From the lamprey's proto-brain to the vastly more complex and richly connected brain of mammals, then primates and humans, the evolutionary lineage is well charted. And as brains become more complex, making possible not just direct responses to the external environment but also reflection on it, so sensory consciousness becomes enriched, and the basic distinction between self-not-self transmuted into a recursive self-awareness. The fine details of evolutionary history and neuroanatomy are notoriously complex, and well larded with unpronounceable dog-Latin terms, and they don't make for easy reading. But the authors write with elegance and lightness of touch, and have been blessed with a superb illustrator. As we can't wind the tape of history back and rerun it, we'll never be able to be sure that the story Feinberg and Mallatt tell is right in all its details, but their neuroevolutionary approach is the best we will have if we are to respect the power of our own human consciousness and also to locate it within a biological framework. As they cheerfully admit, neuroevolution does not solve the "hard problem". But then perhaps it isn't a real problem at all, but a ghostly remnant of a past dualistic way of thinking.

• Steven Rose and Hilary Rose's new book, *Can Neuroscience Change our Minds?* is published in June.