

MIND OVER MATTER

One man's quest to understand one of the hardest problems in science has resulted in a radical new theory of how we see the world. **by GR G DIXON** illustration by ANNA CRICHTON

You bes si down, because wha I am about o ell you may jus blow your mind. The way we perceive hings is no how i seems. You probably believe ha he world comes o you, ha your senses are magnificent pic ure windows, and hrough hem life's sigh s, sounds and exci emen s rush in o your mind.

You may hink ha a ree or person ou here in he world leads o a percep ion of a ree or a person inside your mind, and ha he hing doing he perceiving, he self – ha 's he you inside you – is con inuously soaking in all his sensory informa ion, which you use o guide yourself hrough your environmen and life.

All ha sounds about righ , doesn' i ? Tha your brain is some sor of fancy compu er, a hing made for busily processing da a coming in from your senses, which i urns in o a full-colour film made wholly for he benefi of you?

The ouble is, his isn' rue. As Bri ish neuroscien is Anil Se h explains in *Being You*, his persuasive, beau ifully wri en book on he la es science of consciousness, our percep ions of he ou side world are no an ou side-in experience, bu qui e he opposi e: an inside-ou cons ruc ion by your brain.

"Jus because i seems ha he world pours i self in o he mind hrough he ransparen windows of he senses does no mean ha is wha is going on a all," Se h ells he *Listener* from his home in Brigh on. "In fac , i can' be ha .The impor an s uff ac ually flows from he inside ou , which

seems weird because he world doesn' seem like ha o us."

The la es unders anding of consciousness sugges s our brains spend our lives doing some hing much more in eres ing han merely processing da a from our senses so we migh enjoy a sunse or avoid walking in o he furni ure. In shor , he new science of consciousness con ends ha wha our brains are really doing is "bes guessing" he world and ourselves. A brain isn' a mere compu er, bu a complex predic ion machine.

If ha sounds almos oo s range o be rue, i migh help o know ha even Se h,

A brain isn't a mere computer, but a complex prediction machine.

who has spen 20 years researching and hinking about consciousness, finds i necessary o remind himself ha how we ac ually perceive he world is differen from how i seems.

"I do often in my life jus medi a e on his as I walk around in he world: 'So, his is a projec ion.' I doesn' mean ha no hing exis s, or no hing is here, or ha my mind makes up reali y. I jus means ha he way we experience he world is always as his cons ruc ion."

In fac , Se h wri es in *Being You*, our conscious percep ions of he world are no jus cons ruc ions, hey are "con rolled hallucina ions ha arise wi h, hrough, and because of our living bodies". Be you're glad you sa down.

HISTORICAL ACCIDENTS

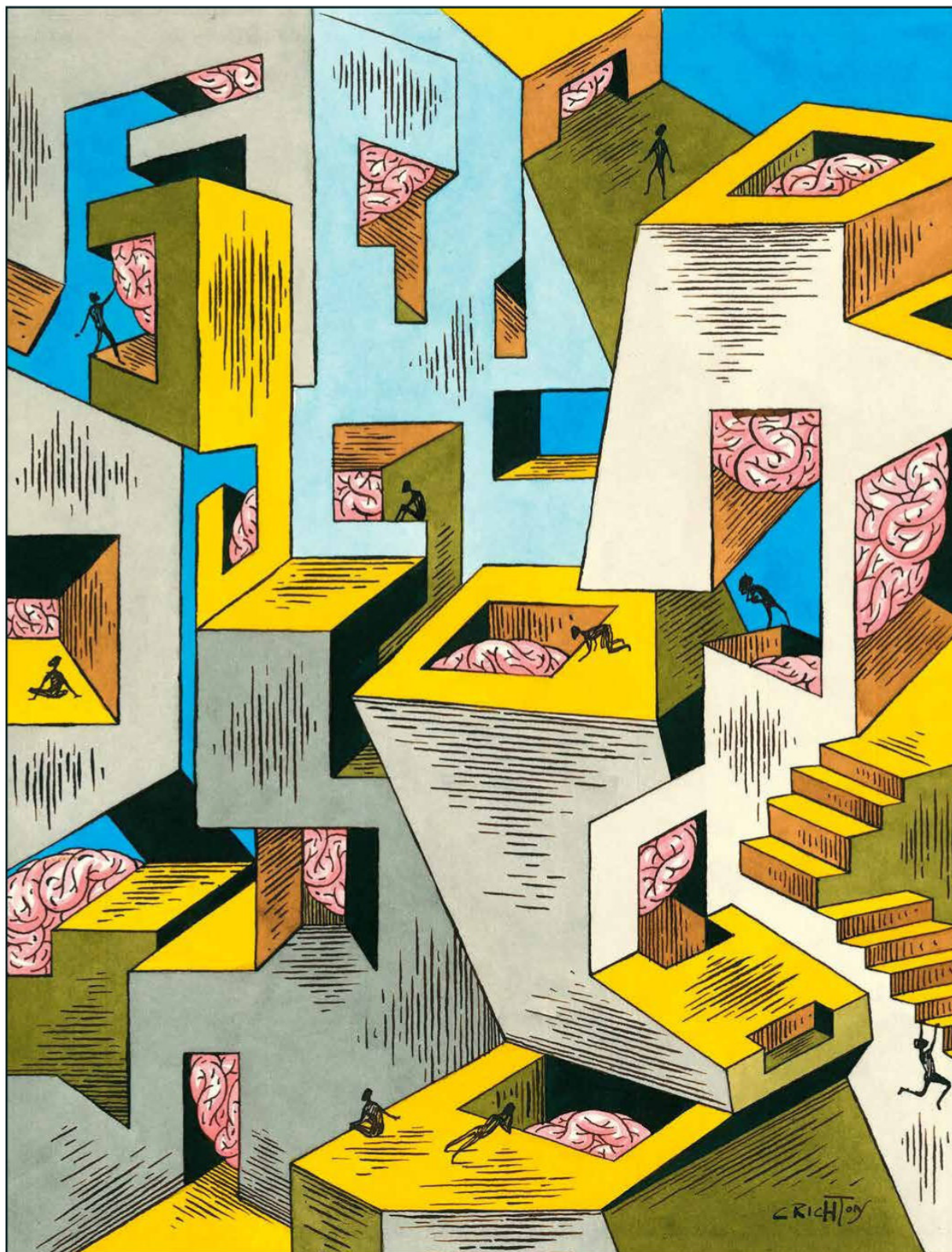
Bu before we ge o hallucina ions, con rolled or o herwise, a li le his ory.

Al hough humans have probably con empla ed he mys eries of consciousness for millennia and Eas ern religions and Wes ern philosophers have mused on i s na ure over cen uries, modern science long rea ed consciousness like some mad aun in he a ic: everyone knew she was up here bu no one wan ed o alk about her.

I wasn' always so. A he bir h of neuroscience and psychology in he 19 h cen ury, consciousness was in fac a cen ral ques ion, par icularly for one of psychology's founding fa hers, William James, he man commonly credi ed wi h coining he erm "s ream of consciousness". Bu for mos of las cen ury, consciousness remained largely uns udie by serious researchers because of wha Se h calls "weird and unfor una e" his orical acciden s.

"The problem was ha as psychology and neuroscience developed, here was an increasing focus on me hod and he reliabili y of da a," Se h says. "Psychology moved from being some hing based more or less on in rospec ion, on people saying wha hey were hinking or seeing or feeling, o lab-based experimen s where people were measuring hings like how long i ook someone o press a bu on when shown an image."

Se h says a backlash arose agains he in rospec ion approach, bu he backlash wen "insanely far", o he ex reme end of he area of s udy ha became known as behaviourism. "Behaviourism no only said, 'Le 's no s udy consciousness,' i said, 'Le 's no even hink about men al s a es a all. We can' observe hem direc ly, we



Gorilla encounter

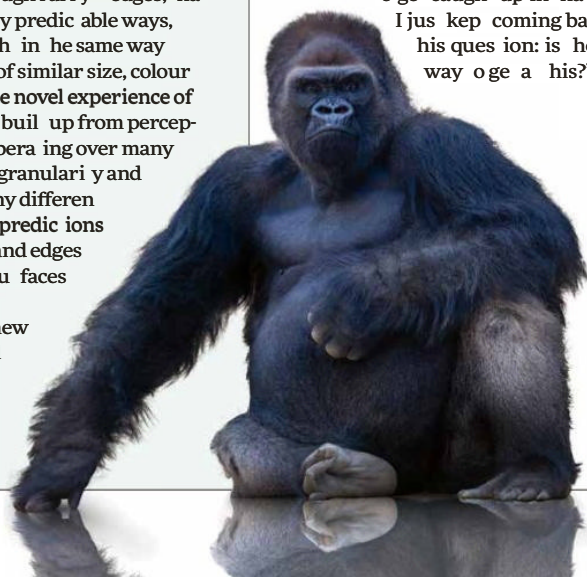
Our brains use a perceptual “best guess” to identify things for the first time.

If our brains are prediction machines, how do we pre-exist in eternal models of the world? To best guess what's going on around us, how do we perceive and comprehend something we've never encountered before?

British neuroscientist Anil Seth says, in his new book *Being You*, that while the inside-out model of consciousness may make it seem that we need a preformed “best guess” for everything that we might ever have to perceive in our lives, this isn't the case. If, for example, you had never seen a gorilla before, and then encountered one ambling down the street, he guarantees that you would still see a gorilla.

“How can this happen?” he writes. “The short answer is that ‘seeing a gorilla’ is never a completely new perceptual experience. Gorillas are animals with arms and legs and fur, and you – and your ancestors – will have seen other creatures that have some or all of these features. More generally, gorillas are objects that have defined – though fuzzy – edges, that move in reasonably predictable ways, and that reflect light in the same way that other objects of similar size, colour and texture do. The novel experience of ‘seeing a gorilla’ is built up from perceptual predictions operating over many different levels of granularity and acquired over many different timescales – from predictions about luminance and edges to predictions about faces and posture – that together sculpt a new overall perceptual best guess, so that you see a gorilla for the first time.”

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“can't put a mental seal on a table. So if you can't do that, it's not scientific. So screw it, let's just look at what organisms do, animals do, and describe that, and that will be the complete science of psychology.”

Seth has ensured that his behaviourism has been valuable; indeed, some of his early teachers were among the 20th century's leading behaviourists. But what brought the study of consciousness back into the fold was that new technologies such as brain imaging arrived, so we could look inside the living human brain.

“Very importantly, there were a few quite courageous researchers who, having got their Nobel Prizes, decided that they were going to go after consciousness – maybe because they wanted another [Nobel Prize],” Seth says, then laughs. “Or it was just because they recognised that something needs to make it okay to study consciousness, because it exists.”

Seth, who is a professor of cognitive and computational neuroscience at the University of Sussex and co-director of the Sackler Centre for Consciousness Science at the university, says he was very lucky to come into the field just as it was “no longer embarrassing”. By 2001, when he began his post-doctoral work on consciousness, he was even able to get funding to investigate it.

“I didn't expect to end up studying consciousness or begin with, precisely because very few people were doing it – and it wasn't really very clear what ‘doing it’ would be. There was no department of it. And there was some fairly rubbish stuff around, so I didn't want to get caught up in that. But I just kept coming back to his question: is there a way of going about this?”

THE “HARD PROBLEM”

Once he had a question about her, a bit, he first two questions about her were obvious: what is consciousness, and how does it happen?

In answering the first question, there are several theories, but Seth favours the thoughts of the philosopher Thomas Nagel, who in 1974 published a now-famous article with the wonderfully whimsical title “What is it like to be a bat?”

As Seth writes in *Being You*, Nagel concluded that while humans could never

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experience what a bat experiences, there would nonetheless be something it was like for the bat to be a bat.

This is a philosophical approach to consciousness called “phenomenology”, the study of the subjective or feeling-based properties of conscious experience. For an organism to have consciousness, it must have some kind of phenomenology about itself. Put simply, for a conscious creature, there is something it feels like to be that creature. It feels like something to be you, it feels like something to be me, it feels like something to be a bat. This, at a simple level, is consciousness.

The answer to the second question, how does consciousness happen? – how does the physical thing that is the brain create a consciousness experience of, say, the colour red? – has proven much more difficult. Dubbed the “hard problem” of consciousness by Australian philosopher David Chalmers in the mid-1990s, it is quite possible we will never know how or why consciousness arises from physical matter.

Knowing this, Seth began thinking, assimilating and pondering the insights of others before coming to the view that the only way for the science of consciousness to move forward was for it to put the hard problem on one side and find another approach. Part of his new method was to break the study of consciousness down into smaller pieces, then work away at each. But what was also needed was a much more multidisciplinary approach.

The Sackler Centre brings together no



Anil Seth:
“We’re going
through this
transition where
we will begin
to understand
consciousness
as part of the
wider tapestry of
nature.”

just neuroscience is like himself but psychologists, psychiatrists, brain imagers, virtual-reality experts, mathematicians and philosophers. “I have always been suspicious of single-disciplinary anything,” says Seth. “My whole academic career has been discipline hopping, because this is what naturally happens when you’re driven by questions rather than by just ploughing the furrow of whichever university department you happen to be in.

“One of the things that happened, from the 1990s on, was this dialogue began between philosophers and psychologists and neuroscientists. And it has become much more bedded in now. It is less acceptable for a neuroscientist to make grand claims without a sensitivity to the philosophy, for example. I have found [the multidisciplinary approach] exciting, essential and just mandated by the nature of the subject.”

Meanwhile, his newer, practical approach to studying consciousness

involved stepping around the hard problem and instead pursuing what he decided to call the “real problem” of consciousness.

“According to the real problem,” Seth writes, “the primary goals of consciousness science are to explain, predict and control the phenomenological properties of conscious experience. In short, addressing the real problem requires explaining why a particular pattern of brain activity – or other physical process – maps to a particular kind of conscious experience, not merely establishing what it does.”

BEAST MACHINES

There are big ideas in *Being You*, so it’s perhaps no unexpected horseless familiar with the science of consciousness find Seth’s notions compelling. But the book has also attracted high praise from other big thinkers on the subject, including the eminent British neuroscientist Karl Friston, whose radical “free energy principle” theory Seth discusses. Friston has called

the book “irresistible”.

Tony Lamb, professor of psychology at the University of Auckland, says *Being You* is important and exciting because it demystifies consciousness. “What I liked about it is it presents a grand vision. It is removing the illusion that consciousness is going to have one kind of solution. Seth is saying consciousness is a whole bunch of different things and we can make progress by chipping away at it.”

Seth has broken his grand vision of consciousness into three key meanings or

“I predict myself, therefore I am,” meaning that the self is just another construction.

components: the level of consciousness, the content of consciousness and the self – the consciousness experience of being you or me or a bat.

The book begins with the latest thinking about levels of consciousness and new research in measuring: is consciousness level something like temperature, a single property, or more like life – a complex combination of properties and mechanisms? In the section on the self, Seth develops the idea that we are “beast machines”, that our bodies are part of our sentience.

As mind-bending as those discussions are, it is when the book examines how our brains perceive the world and ourselves that we feel a little like we are through the looking glass.

In his warm, crisp, unshowy way, Seth explains that our brains, sitting inside our skulls and cut off from any direct connection with the world, perceive it by creating complex blueprints, or models, of what the world outside is like, which the brain then uses to make predictions about what’s going on around us. “There are neurons being connected in particular ways that encode these models of the world that send predictions [about the world] back out to the senses and then the sensory data updates these predictions in different ways,” Seth says. In his way, our prediction-machine brain is constantly guessing the world and constantly updating its blueprints or the models using our senses to minimise errors, and employing “Bayesian inference”, a kind of

C. RIOS/SCOTT LAM

Hype & hysteria

Conscious machines are still a long way off, if they are even possible at all, says Anil Seth.

It's an enduring science-fiction nightmare: the man-made machine that becomes conscious and then sets about destroying its creator. The likelihood of someone developing a conscious, possibly malevolent, machine has now become a real-world worry thanks to rapid advances in artificial intelligence and machine learning. So, is *The Terminator* scenario a possibility?

British neuroscientist Anil Seth believes that the possibility of conscious machines is likely to be far off, if ever feasible. Much of today's artificial intelligence (AI) is just "sophisticated machine-based pattern recognition, perhaps spiced up with a bit of planning".

In *Being You*, he writes that intelligence is not the same as consciousness, and it is a mistake to assume that intelligence is either necessary or sufficient for consciousness. "For some people – including some AI researchers – anything that responds to stimulation, learns something or behaves so as to maximise a reward or achieve a goal, is conscious. To me, this is a nonsensical overextension of what 'being conscious' reasonably means."

Given the current level of hype and hysteria around AI, it is hardly surprising that many people think that conscious AI is just around the corner and are worried about what happens when it arrives, he says.

"The possibility [of conscious machines] cannot be ruled out completely. But from where we stand now, the prospect is extremely unlikely."

More probable and concerning is that in the near future, AI and robotics will produce something that has the appearance of being conscious, and that will be able to fool people that it is conscious even though it has no inner life.

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No inner life: the Spot robotic dog, which can map its environment and sense and avoid obstacles.

probability reasoning first advanced by Thomas Bayes, not a modern statistician but an 18th-century Presbyterian minister.

Our brains aren't just prediction machines for the outside world, either. The same brain mechanisms essentially predict the self. In Seth's words, "I predict myself, therefore I am", meaning that the self is just another construction. "To put it another way," Seth writes, "for as long as we live, the brain will never update its prior belief of expecting to be alive."

CONTROLLED HALLUCINATION

All this, then, is what Seth means by "controlled hallucinations", a new idea picking up on some very old ones in philosophy and psychology. It goes back at least as far as 18th-century German philosopher Immanuel Kant, he says. "He was saying that everything we perceive is indirect and the real world is hidden behind

"For as long as we live, the brain will never update its prior belief of expecting to be alive."

his sensory veil. And one of the earliest psychologists, German physicist and physiologist Hermann von Helmholtz, was the first person to bring a more scientific and formal perspective on this, to think about perception as his process of best guessing and inference, and that the brain is always trying to make a guess about what is out there based on its prior beliefs and whatever the sensory data says."

Seth says while these early thinkers laid out the philosophical and psychological basis for understanding the brain as an inside-out prediction machine, it is only recently that neuroscience, with all its modern techniques, has begun working through how this happens. "Now we can begin to understand it as an actual mechanism, not just a weird metaphor."

Seth says the term "controlled hallucination", a phrase he first heard from the British psychologist Chris Frith many years ago, is not the perfect description of what the brain does.

"It is very hard to find the right word, because illusion isn't right, either. There is no ideal word. The reason I ended up fixing on controlled hallucination was because, when we typically think about hallucinations, we typically think of something being generated by the mind, a perception that is coming from within – like a dream. So that, for me, is the important point: there is a continuity between the colloquial meaning of hallucination and perception – they are both primarily coming from within."

But the "control" element is crucial. Seth is not saying that our perceptions are arbitrary and bear no relation to what's out there in the world. In fact, our perceptions have a very intimate relationship with what is out there in the world, or indeed in the body.

"Otherwise, our brains would be useless. Evolution has tuned our perception so that these hallucinations are very, very adaptive and tightly controlled in the ways that best serve our survival prospects."

The most confounding bit of the whole consciousness puzzle may well be the self. It is important to understand that the self and consciousness are not the same thing, Seth says, but in a way the self is the center of consciousness because all of our other experiences end up being referred, at some level, to our experience

