

Special report: The brain ▾

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Who do you think you are?

Modern neuroscience, says Geoffrey Carr, is groping towards the answer to the oldest question of all: who am I?

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ON SEPTEMBER 13th 1848 a navy called Phineas Gage was helping to build a railway in Vermont. As gang foreman, he had the job of setting explosive charges to blast a path through the hills near a town called Cavendish. While he was tamping down one of the charges with an iron bar, it went off prematurely, driving the bar clean through his head.

Accidents on construction projects happen all the time. The reason that people remember Gage's is that he survived it. Or, rather, his body survived it. For the Gage that returned to work was not the Gage who had stuck the tamping rod into that explosive-filled hole. Before, he had been a sober, industrious individual, well respected and destined for success. Afterwards, he was a foul-mouthed drunkard, a drifter and a failure. His identity had been changed in a specific way by specific damage to a specific part of his brain.

Gage's accident was intriguing because it cast light on the question of dualism. This is the idea that although the mind—the self—inhabits the brain, it nevertheless has an existence of its own and thus should not be equated with the brain. The sudden change Gage underwent suggested that brain and mind are not independent. If the essence of individuality can be changed by a physical accident, it implies that the brain is a mechanism which generates the self, rather than merely an organ which houses it. This observation moves the question “who am I?” from the realm of philosophy into the realm of science.

Thirteen years after the incident in Cavendish, a French neurologist called Paul Broca systematised the study of how brain damage affects the mind with the discovery that certain sorts of speech defect are the result of damage to part of the brain called the left temporal lobe (see [article](#) for a refresher course on brain anatomy and function). Local brain damage of this sort is known to neurologists as a lesion. Studying it therefore became known as the lesion method.

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neurological symptoms are now explained by specific brain damage. For example, an inability to perceive movement (even though the individual can see stationary objects) results from damage to part of the temporal lobe, and an inability to recognise faces is caused by damage to the fusiform gyrus. No one now questions the idea that particular parts of the brain specialise in particular activities.

Broca's revolution, though, is incomplete. On the face of things, its discoveries might have meant the end of dualism, but the world was not quite ready to embrace the mechanical explanation of self that the work of Broca and his successors implied. For much of the 20th century, a watered-down version of dualism based on the idea of the psyche prevailed. The distinction that psychiatry drew between neurological and psychiatric illness implied that there was a psyche (whisper not the word soul) that could somehow go wrong independently of physical symptoms in the brain.

When that idea was challenged by the effectiveness of physical drugs, such as antidepressants, in treating psychiatric illness, dualism returned in a different guise. Many people, most of whom would not regard themselves as dualists, think of the brain as being like a computer, and the mind as being like a piece of software that runs on that computer. But this analogy, too, is flawed. You do not have to do much damage to a computer to stop it being able to run programs. Yet as the case of Gage and numerous subsequent individuals has shown, the self can plod on, albeit changed, after quite radical brain damage.

The self in action

Broca's heirs, though, now have a range of new techniques with which to investigate the question. The best-known is a way of scanning the brain called functional magnetic-resonance imaging (fMRI). What makes it so powerful is that it records activity as well as anatomy. It can, if you like to put it that way, see the self in action. All you need to do is put someone inside an fMRI machine, give them a task to do and see which bits of the brain light up.

Naturally, the revolution in neuroscience brought about by this new technology has its critics. They point out that big conclusions are often drawn from small samples, that the changes in activity observed by fMRI are indirect (the technique measures blood flow and oxygen consumption rather than the



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
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
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resolution is poor (individual points in an fMRI picture represent two or three cubic millimetres of brain tissue, which means hundreds of thousands of nerve cells). All these criticisms are justified. But these are early days. In science, time tells. The good studies are repeated and make the textbooks. The bad ones cannot be replicated and vanish down the memory hole.



Modern neuroscience has taken many directions, and this survey will not attempt to look at all of them. Instead, it will concentrate on four areas that may shed light on individual identity: the study of the emotions; the nature of memory; the ways that brains interact with each other; and the vexed question of what, exactly, consciousness is.

Such science is very much work in progress. Indeed, it is science of a type that would have been familiar to Broca and his contemporaries, for in many cases the researchers have only the haziest idea of where they are going. In the 19th century, when scientists were feeling their way towards big concepts such as the laws of thermodynamics, electromagnetics and the periodic table without really knowing what they were looking for, that was normal. These days there seem to be fewer new big concepts around, and experiments are often conducted in the expectation of particular results. But neuroscience is one area where big concepts certainly remain to be discovered. And when they are, they are likely to upend humanity's understanding of itself.

• This article appeared in the Special report section of the print edition

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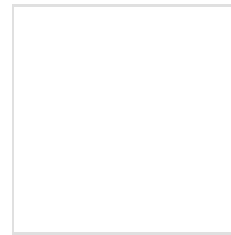
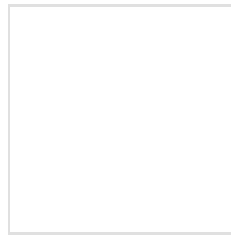
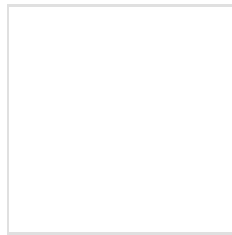
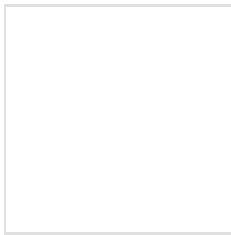
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