Head start

Europe's mega-project to simulate the human brain has much to offer neuroscience research — whether or not it delivers on its central promise.

From supercomputing to imaging, technologies have developed far enough that it is now possible for us to imagine a day when we will understand the murky workings of our most complex organ: the brain.

True, that day remains distant, but scientists are no longer considered crazy if they report a glimpse of it on the horizon. This turning point has been marked by the independent launches this year of two major brain projects: US President Barack Obama's Brain Research Through Advancing Innovative Neurotechnologies (BRAIN) Initiative and the European Commission's Human Brain Project. Even if they fail to achieve the ambitions the research community sets for them, they are signals of a new confidence.

Right now, the two projects are not equal. The BRAIN Initiative is in an early phase of development, and has so far been promised little new money. The impetus behind it was a brash proposal by a group of neuroscientists for a billion-dollar project to measure the activity of every neuron in the human brain. That ambition was lost on the starting block when peers, justifiably, deemed it scientifically inappropriate — but is yet to be replaced by a single goal of equivalently Apollo-program proportions (see page 26). This may make it hard to maintain the political support large projects always need.

Conversely, the Human Brain Project — headquartered in Switzerland, where it will soon relocate from Lausanne to its new base in Geneva — has 135 partner institutes and is blessed with a plenitude of money and planning. And it has a romantic Moon-landing-level goal: to simulate the human brain in a computer within ten years, and provide it to scientists as a research resource. Programme leaders have committed €72 million (US$97 million) to the 30-month ramp-up stage; those monies started to flow into labs after the project's launch last month. The project has a detailed ten-year road map, laden with explicit milestones.

UPS AND DOWNS

But will the Human Brain Project realize its pioneers' greatest ambition? Many have raised doubts, arguing that we understand too little about how the brain works to make the ambition feasible. However, the project's scope has matured since the idea was first mooted in 2010, in ways some believe may increase its chances. Initially, it was conceived as a programme whereby bottom-up experimental data — electrophysiological, anatomical or cellular — would feed into a supercomputer without preconceived ideas of how the simulated neuronal circuitry might organize itself. A top-down element has now been introduced.

The bottom-up data feed — mostly from research on mice — remains a core component, but how it is processed in the brain simulator will be guided by the findings of one of the Human Brain Project's 15 subprojects, on high-level human cognitive architecture. This will generate data for both animals and humans, describing how cognitive tasks, such as those involving space, time and numbers, are processed in the brain. For example, in one major research project, around ten people will be selected for repeated study during the decade-long project. Their 'reference brains' will be measured using a range of non-invasive techniques such as functional magnetic resonance imaging and electroencephalography to work out how the relevant neurocircuitry is organized during specific tasks. The detailed bottom-up data will have to align with this broad architecture.

Another subproject, on neurorobotics, will build or simulate robots to provide 'bodies' in which to test whether simulated brain models really do elicit the behaviours anticipated.

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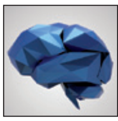
Supercomputing has proved too slow for real-time brain simulation, so other subprojects will focus on developing faster supercomputers, as well as neuromorphic computing, which can theoretically simulate brain activity orders of magnitude faster than occurs in a real brain (see page 22). Neuroinformatics, medical informatics and ethical challenges are all in there too.

The Human Brain Project may still fail to deliver on its central promise, at least at the desired degree of sophistication. It remains a high-risk initiative, and keeping the unwieldy, multidisciplinary consortium on track may also prove difficult. But the risks are spread over the subprojects, some of which will inevitably add significantly to our sum neuroscience knowledge.

And some will inevitably achieve the European Commission's original goal for the project — it is often forgotten that it was not specifically about the brain at all. In 2010, the commission launched a call for proposals for billion-euro, ten-year flagship projects that would push the development of information and communication technologies while offering a benefit to society. The Human Brain Project, with its relevance to brain disorders in an ageing society, was one of two winners. This heritage, which may turn out to be its greatest strength, explains its unusual interdisciplinarity.

The project will absorb more than €1 billion in the next ten years, half of which will come from the European Commission and half of which will be raised by participants, including a large chunk from Switzerland. But it is much more international than this implies. Although most of the partner institutes are in Europe, some are further afield, in countries including Israel, Japan and the United States. The battle for the brain could be won faster with a global effort, and many will be attracted by the Human Brain Project's systematic approach.

But before getting too starry-eyed about mega-projects, let's remember that major breakthroughs in understanding the brain will continue to emerge from the labs of individual investigators. The journey towards a full understanding of the brain will be long and uncertain, and there will be ample opportunity for individual contributions to help point the way. ■



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