Abstractions

LAST AUTHOR

Presenilins are a family of membrane proteins that were linked to hereditary Alzheimer's disease more than a decade ago. Although presenilin inactivation was known to lead to impaired memory and neurodegeneration, two key features of Alzheimer's disease, how it did this was not clear. Now Jie Shen at Harvard Medical School and her colleagues have shed new light on the functions of presenilins by showing that they regulate neurotransmitter release at synapses — the specialized connections between neurons — in the mouse hippocampus (see page 632). Shen tells *Nature* more.

Why did you focus on the hippocampus?
Because this region is essential to learning and memory, and is particularly vulnerable in Alzheimer's disease. In addition, the synaptic mechanisms that underlie memory have been best studied in the hippocampus. Synapses pass information chemically from a presynaptic cell to a postsynaptic cell. We were able to genetically inactivate presenilins in mice in either pre- or postsynaptic hippocampal neurons.

Did presenilin inactivation have different effects on pre- and postsynaptic neurons?
Yes. Synaptic transmission and plasticity — the ability of the synapse to change in strength — were normal when presenilins were inactivated in postsynaptic neurons. By contrast, when we inactivated presenilins in presynaptic neurons, we observed an impairment in the induction of long-term potentiation, a form of synaptic plasticity that is thought to underlie memory formation.

What causes the impairment?
All presynaptic neurons contain neurotransmitters enclosed in small, membrane-bound vesicles. We determined that presenilins are required in presynaptic neurons for regulating the release of the neurotransmitter glutamate, which is essential to synaptic transmission and plasticity. If we depleted intracellular stores of calcium, or blocked intracellular calcium release, we could mimic the effects of presenilin inactivation in presynaptic neurons. This suggests that presenilins control neurotransmitter release by regulating the release of calcium from intracellular stores.

What are the implications for human health?
There is increasing evidence that loss of presenilin function may have an important role in the development of Alzheimer's disease. We identified the earliest pathogenic changes caused by loss of presenilin function: impaired neurotransmitter release and impaired calcium homeostasis. These might provide new therapeutic targets. ■

MAKING THE PAPER

Peter Read

Atmospheric maps lend a hand to calculating Saturn's rotation speed.

NASA's Cassini mission has collected a treasure trove of data about Saturn. Among these, three-dimensional maps of the planet's atmosphere have allowed researchers to apply a novel approach to determining the still uncertain period of Saturn's rotation. Peter Read and his colleagues set this at 10 hours, 34 minutes and 13 seconds (see page 608).

Rotation rates of planets that have a solid surface, such as Earth and Mars, can be easily determined by tracking landforms. But for the 'gas giants' like Jupiter and Saturn, such measurements are trickier. Saturn's outer layer, for example, is primarily made up of hydrogen gas. Deeper down, the gas becomes a hot liquid. "The deep interior of the planet probably does rotate almost like a solid body, even though it's actually made of a fluid," says Read, a physicist at the University of Oxford, UK.

But how do you measure the rotation of this hidden interior? Jupiter's rotation can be easily established by tracking the relative rotation of the planet's two north poles — magnetic north and geographic north. But Saturn's magnetic north is too close to its geographic north to be used as a marker, so scientists have had to work with less direct tracers of magnetic fields. However, rotation rates calculated using such methods were found to change drastically over time. "That tells us that the measurement is not directly related to the rotation of the deep interior," says Read.

So Read started work on a different approach. He applied fundamental principles of fluid dynamics to an analysis of the wind and thermal data that the Cassini team was collecting, even before the spacecraft began orbiting Saturn in 2004. He then teamed up with Timothy Dowling, a physicist at the University of Louisville in Kentucky, who had been working for more than a decade on the idea that a planet's atmospheric circulation could be determined by tracking cloud movements. With the three-dimensional data from Cassini, the researchers could better describe waves in the upper level of the atmosphere and relate that information to what is happening deep inside the planet. This is because slow-moving waves penetrate far into the planet's interior, and may be affected by its internal rotation. Using this method, says Read, "We end up with a rotation period for Saturn that differs by more than 5 minutes from that which our colleagues in the magnetic fields teams calculated and have been trying to verify."

The rotation rate agrees with that previously determined by the third member of the team, geophysicist Gerald Schubert of the University of California, Los Angeles. He had tried to deduce Saturn's interior rotation rate by a completely different method — using gravity fields and the shape of constant pressure surfaces in the atmosphere — which gave Saturn a day length of 10 hours, 32 minutes and 35 seconds (J. D. Anderson & G. Schubert *Science* **317,** 1384–1387; 2007). "That was greeted with some interest, but quite a bit of scepticism, because it was so different," Read says.

Given that something is amiss with the rotation rate calculated from magnetic-field data, independent derivation of similar rates by two very different methods makes for a strong case, although it awaits further confirmation. Read says that this change in bulk rotation period has significant implications for models of the deep interior structure and evolution of Saturn. ■

FROM THE BLOGOSPHERE

No one ever told Graeme Jones not to play with his food. The chemical ecologist and sculptor has created a sci-art exhibit for the British Royal Society of Chemistry (RSC) called *Carbon Rapture*. It relates to the RSC's 2009 'food' theme, and features larger-than-life chemical models of different forms of carbon, "the chemical present in all foods", as blogger Chloé Sharrocks writes on Nature Network's London blog (http://tinyurl.com/nns22n).

The exhibit graces the courtyard of the RSC's Burlington House headquarters in London, with models including the translucent pyramid of *Diamond* and the geometrically pleasing *Buckyball*. Sharrocks, a science communication graduate student at Imperial College London, writes, "Graeme is a passionate scientific communicator who has, in his own words, spent the last few years 'trying to re-establish science at the heart of culture'".

Jones thinks that science has lost its cultural identity, and that this plays into the public's mistrust of it. He hopes that his exhibit, which will run until 27 August, will help the public better appreciate scientific endeavour. ■

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