TOOLBOX

‘Magneto’ manipulates behavior of freely moving mice

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22 JUNE 2016

A modified protein allows researchers to use a magnet to switch on neurons anywhere in the brain in freely moving mice and zebrafish. The tool, described in May in *Nature Neuroscience*, could shed light on neural circuits underlying autism-like behaviors in animal models of the condition[1].

Scientists can already turn neurons on and off at will with a **technique called optogenetics** that renders the cells sensitive to light. But that method requires surgically implanting a light source near the cells they want to manipulate.

The researchers rendered an ion channel in neurons called TPRV4 magnetically sensitive by fusing it to ferritin, a protein rich in iron. TPRV4 is ordinarily heat- and pressure-sensitive, but the researchers reasoned that, when attached to ferritin, it would also open in the presence of a magnetic field. Opening the channel causes calcium to flow into the cell, prompting it to fire.

Placing a magnet near cultured kidney cells expressing the protein, dubbed ‘Magneto,’ causes a calcium-sensitive fluorescent probe inside them to light up within seconds. And placing a magnet next to brain slices from mice that had been ‘infected’ by a virus carrying the Magneto gene causes neurons in the slices to fire. This firing stops when the tissue is bathed in a drug that blocks TPRV4.

The team also inserted the protein into neurons in the mouse striatum, an interior brain region that processes rewards and is difficult to target using optogenetics. Placing the mice in a magnetized chamber triggered firing of these neurons. Mice injected with Magneto spent more time in the magnetized chamber than in an adjacent non-magnetized area, suggesting that they experience a ‘reward’ when the magnet activates the neurons.

Magneto is likely to be still sensitive to temperature and pressure, making it hard to precisely control. But the researchers say that flaw may be fixable.

REFERENCES:

1. Wheeler M.A. *et al. Nat. Neurosci.* **19**, 756-761 (2016) **PubMed**