Abstractions

LAST AUTHOR
Rats have innate mapping ablities — scientists discovered in 2005 that the rodents maintain a grid-like map of their location by means of a network of brain neurons dubbed 'grid cells'. These cells have also been found in mice, but whether a similar mechanism operates in humans has been unclear. Neil Burgess, a neuroscientist at the Institute of Cognitive Neuroscience of University College London, and his colleagues have now found evidence that the human brain also contains grid cells that act like a spatial map (see page 657). Burgess tells *Nature* more.

How do grid cells behave?
Grid cells fire according to an animal's location in its environment: different cells fire in different locations. If the geographical locations at which a grid cell fires were plotted on the ground, they would form the vertices of a regular triangular array, or grid. The grid patterns of all the cells have the same orientation. Some grid cells fire more than usual when the animal is moving in a particular direction, and these 'preferred' directions line up with the axes of the grids. In this way, the regular spatial firing patterns of grid cells provide information to the animal about the distances and directions in which it has travelled.

How did you look into the possibility that humans have grid cells?
We can't implant electrodes in people's brains to record the activity of individual neurons as grid cells were studied in rats, but we can measure the combined activity of thousands of neurons at once using functional magnetic resonance imaging. We figured that when a person explored the environment of a virtual-reality video game we would see changes in the firing patterns of all their grid cells as the person 'ran' in different directions. We believed that there would be different patterns of firing when a person was running along one of the axes of the grid compared with when they were running between axes. So we theorized that the imaging signal would be high whenever people ran in the directions of the axes and low when they ran between them. And that is what we found.

Was there much variation between people?
The part of the brain we looked at, the entorhinal cortex, is associated with being able to find your way around, and if it is damaged this ability may be compromised. We noticed that across the 42 individuals whose brains we scanned, those who had the most consistent MRI readings across voxels in the entorhinal cortex were the ones who remembered locations best. It may be that the better organized your grid is, the more easily you can find your way around. ■

MAKING THE PAPER

Lei Jiang

Spider silk structure holds secret to catching water as well as flies.

Anyone who has seen a spider web after the early morning dew will have noticed water droplets strung along its fine threads. When Lei Jiang first observed the phenomenon, he was intrigued. "How does that happen?" He wondered. After all, he says, "if you took a human hair, water would not stick to it like that". His initial curiosity led to an almost five-year-long study. The findings could have implications for the design of materials for water collection and for the efficiency of chemical reactions.

Spider silk's structure has been studied extensively for its incredible strength and flexibility. But Jiang, a chemist at the the Institute of Chemistry, Chinese Academy of Sciences, is more interested in its wettability — its ability to maintain contact with liquids. "Large water drops can hang stably on the thin spider silk," he says. "My colleagues and I thought it likely that a microstructural mechanism was responsible for the water collection."

To look for this mechanism, Jiang enlisted the help of three postdocs and a graduate student, and between them they collected several hundred webs, each about 10–20 centimetres in diameter, made by a local species of spider called *Uloborus walckenaerius*. The researchers carefully separated silk threads from the webs and then examined them using an environmental scanning electron microscope, which allows samples to be observed at high relative humidity in low-pressure gaseous environments.

Spider silk is made up of hydrophilic, or 'water-loving', nanofibrils. When dry, these form a string of loose 'puffs' linked by joints. When Jiang and his team humidified the sample chamber, tiny water droplets started to collect on the joints and puffs. As a result, the nanofibrils turned from puffs into larger and denser 'knots'. The water droplets then began to be transported from the joints towards these knots, where they coalesced into sticky and adhesive drops.

Further work revealed that movement of the droplets towards the knots is directed by two forces acting together: the force generated by a gradient of surface energy on the fibrils and the one produced by the spindle shape of the knots (see page 640). "This is quite different from other reported surfaces, on which drops are driven just by individual forces," says Jiang.

Having elucidated the web's mechanism of water collection, Jiang and his team set to work designing a material with similar capabilities. The project was a success, and Jiang says that the most exciting part of the experiment, which he plans to spend the next decade on, will be finding applications for his fibres. One will be to design a large, artificial web that can collect drinking water from fog. "It is very important to develop materials for water capture that can be used to supply drinking water in places where water is scarce," he says. Another application, he adds, is in "designing materials for smart catalysis" — materials that bring components of a chemical reaction together with the catalyst, promoting faster and more efficient reactions.

Although it is obvious why such applications would be useful to humans, it is not as clear how the spider benefits from water collection. Jiang believes that the structural changes that occur when the web gets wet may serve to 'refresh' the web's structure, making it stronger and more sticky for catching prey. "Many scientists now ask me why spiders collect water," says Jiang. "This is one possible answer." ■

FROM THE BLOGOSPHERE

Two recent blog posts discuss science onscreen. If you didn't read *Nature*'s cover article last week about the forces generated by barefoot runners, you can catch the latest film at Nature Video on the Great Beyond, a clip by the Barefoot Professor (http://go.nature.com/tPTQIH).

In it, Daniel Lieberman of Harvard University in Cambridge, Massachusetts, explains why humans probably evolved to run in a style whereby they land first on the front of their foot — a style favoured by the shoeless. He also demonstrates the method, running cheerily through the snowy streets of Cambridge without his trainers.

Meanwhile, on the Spoonful of Medicine blog, *Nature Medicine* editorial intern Christian Torres reviews the Hollywood movie *Extraordinary Measures* (http://go.nature.com/oDUEpM). The film depicts the true story of a father's quest to save his children from Pompe disease — a fatal muscle disorder.

But, as Torres notes, "the film oversimplifies the story by making industry the villain. [It] also glosses over the intricacies of ... conflicts of interest and the clinical trials process, in favor of an emotional response". ■

Visit Nautilus for regular news relevant to *Nature* authors ➧ http://blogs.nature.com/nautilus and see Peer-to-Peer for news for peer reviewers and about peer review ➧ http://blogs.nature.com/peer-to-peer.