Abstractions

LAST AUTHOR

Being able to read another person's mind is still science fiction. But Frank Tong, a cognitive neuroscientist at Vanderbilt University in Nashville, Tennessee, and his colleague Stephenie Harrison might have brought this fantasy a little closer to reality. Researchers thought that brain areas involved in the earliest stages of visual processing, including the primary visual cortex, could not retain the information they interpret from the signals received from the eye. Using functional magnetic resonance imaging (fMRI), Tong and Harrison have now shown that early visual areas do retain precise visual information about items that are no longer in the visual field — at least for a brief period (see page 632). Tong tells *Nature* more about the discovery.

What did you actually find?

We showed volunteers two striped patterns in different orientations and then asked them to remember one of the patterns for several seconds while we scanned their brains by fMRI — a technique that measures a signal produced by the increase in blood oxygenation that follows neural activity. By decoding the activity in the visual cortex, we could predict in more than 80% of the tests which of the two patterns a volunteer was remembering.

Were you surprised?

We thought we might find some evidence of visual memory in the visual cortex, but we were surprised to find it when brain activity was extremely low. It could be that when you're thinking about something, it is not at the same degree of vividness as when you are actually seeing it. Also, it could be that neurons in the visual cortex can transmit much information with little activity.

How were you able to interpret the signal?

Usually, fMRI signals are measured using 'voxels', a three-dimensional unit of measurement consisting of a few millimetres along each side. We used pattern analysis to pool the weak information contained in many individual voxels to obtain more robust information across the visual cortex. With this method, we can predict what people are seeing, paying attention to or actively remembering.

Will mind reading be possible some day?

We have a long way to go before these techniques could be applied to, say, a criminal investigation, but the possibility of reading out a person's thoughts does exist. But here we were reading out what our volunteers chose to remember, so people have some control over what thoughts can be read out. Right now, what we are doing is still fairly basic. ■

MAKING THE PAPER

Piergiorgio Picozza

An experiment to detect high-energy positrons pays off.

Seventy years ago, scientists first calculated that galaxies must contain additional, undetectable sources of mass — up to five times the mass of the detectable gas and stars. Piergiorgio Picozza, a physicist at the University of Rome Tor Vergata in Italy, has spent his career searching for this invisible 'dark matter', which is proposed as the source of the added mass, and he might now have found evidence for it.

Picozza has been investigating the formation of antimatter in space. Antimatter consists of particles that have the same mass as electrons and protons, but opposite properties such as charge. For example, the positively charged positron is the antimatter counterpart of the electron. Positrons can be produced by 'secondary processes', such as cosmic-ray nuclei smashing into interstellar dust, which occur at relatively low energies, but they might also arise directly from 'primary sources', such as dark-matter annihilations, that could generate positron–electron pairs at high energies. The latter process has not yet been confirmed. So a better understanding of positron formation could indicate the presence of dark matter. "A very important part of our job is to disentangle the sources of positrons," says Picozza.

To gather the necessary data, Picozza organized a collaboration of Russian, Italian, German and Swedish colleagues dubbed PAMELA — Payload for Antimatter–Matter Exploration and Light-nuclei Astrophysics. At first, PAMELA was difficult to get funded as a US-led collaboration had just begun similar work. But Picozza persevered and convinced European funders that two sets of data would be better than one. Specialized high-energy particle detectors to precisely measure the abundance of cosmic rays, electrons, positrons and other antimatter particles were sent into Earth orbit on board a satellite in 2006.

To identify possible primary source antimatter production, the team focused its analysis on the energy interval between 1.5 and 100 gigaelectron volts (GeV). If positrons are produced mainly from secondary sources, the ratio of positrons to electrons detected would be expected to decrease with increasing energy. But, surprisingly, the team found that this fraction increased significantly between 10 GeV and 100 GeV (page 607). The authors conclude that a primary source is needed to generate the high numbers detected at these higher energies.

Picozza is careful not to jump to the conclusion that their results prove that the primary source of antimatter is dark-matter annihilation. Pulsars, relics of massive stars that emit radiation, could also generate positrons. The ultimate confirmation that antimatter particles are produced from dark matter will come only if the Large Hadron Collider (LHC) at CERN near Geneva in Switzerland can experimentally produce 'dark matter particles'. "I remain open-minded about the possibilities, but if the LHC confirms our data, it would easily be the best result I — and more importantly, my young collaborators — will have achieved," says Picozza.

Until then, he hopes to take advantage of PAMELA's remaining time in space to follow antimatter production during a shift from low to high solar activity. The PAMELA data below 10 GeV were obtained in a period of low solar activity, and are remarkably different from previous data obtained during high activity. ■

FROM THE BLOGOSPHERE

Nature Chemistry (www.nature.com/nchem/index.html) has finally arrived! In a post in The Sceptical Chymist (http://tinyurl.com/c73cc8), associate editor Neil Withers announces the first issue, which is "freely available for everyone to read and (hopefully) enjoy".

Uppsala University postdoc and blogger Egon Willighagen has already taken a look (http://tinyurl.com/dfvgon). In his 19 March post, he happily notes that many of the papers have data-rich 'compound pages' in which readers can click on a compound number to view a full structure, with links to online databases.

In other papers, readers can click on the 'Show compounds' link that appears in the right-hand navigation panel and compound names in the text will be highlighted. Clicking these names reveals links to PubChem and ChemSpider.

Willighagen concludes that "*Nature Chemistry* really changes publishing of chemistry". In addition to the usual mix of research articles, reviews, News and Views and Research Highlights, the journal includes Blogroll, a quick overview of what has caught the editors' eyes in the blogosphere. ■

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