Abstractions

FIRST AUTHOR

Studies of the visual system have revealed a lot about how we process simple features of an object such as its shape, colour and movement. Much less is known about how the brain encodes the meaning, or category, of visual stimuli. On page 85 of this issue, David Freedman, from Harvard Medical School, reports the identification of monkey brain cells that they believe allot meaning to objects. These cells are located in the lateral intraparietal (LIP) area, a brain region that uses visual information to help monkeys make decisions such as to move their eyes to or from an object. Freedman teamed up with John Assad, also at Harvard, to show that LIP neurons can code for a specific category and retain that information during a delay period. The information is stored in the monkeys' short-term memory. Freedman spoke to *Nature* about how the brain assigns meaning to moving visual targets.

How did you come to study categorization?
I'm driven by the desire to answer the question of how the brain makes sense of our visual surroundings. We have all these objects around us — such as tables and chairs — and we know what to do with them, but how? We taught monkeys to watch tiny dots drifting in any one of 12 directions and then categorize those directions into two groups of six.

Why use direction of motion rather than, say, chairs?
Partly because we already know a lot about how the brain processes visual-motion patterns — the anatomy and physiology are well understood. And also because so much of our behaviour involves reacting to events in our visual world. If something is moving towards you, do you grab it or move out of its way? We need to understand motion to cross a busy street or recognize whether someone is waving hello or motioning for us to go away. Even simple animals such as flies can detect motion and respond appropriately.

Will this work shed light on memory loss?
People often tell me they hope I will make a pill to improve memory. That is probably a long way off, but we are at least zooming in on areas that have a role in storing long-term memories. This will hopefully lead to a better understanding of amnesia and Alzheimer's, in which people often show impaired learning, memory and recognition.

You've studied aspects of vision since you were in college — why the fascination?
As a student, I attended a course about how the brain makes sense of sensations. I realized these were questions I had been thinking about for years, such as: "Does your red look like my red?". ■

MAKING THE PAPER

Kathy Cashman

Volcano monitoring heats up with new magma knowledge

Volcanologists still aren't particularly adept at working out exactly when volcanic eruptions will occur, how they happen or how long they are likely to last. Now, Kathy Cashman at the University of Oregon in Eugene and her colleagues have found a geological clue about the heating of magma (see page 76). This could help modellers better describe the several-kilometre journey this molten rock makes to Earth's surface.

How magma rises to the surface depends on a number of factors. Many magmas are water-rich, and as they rise the external pressure decreases and water is lost in the form of gas. This water loss changes the properties of the melt such that crystals form and the magma's viscosity increases.

Such factors are of great interest to Cashman and her long-time collaborator Jon Blundy, a petrologist at the University of Bristol, UK. Last year, they published work tracking the decompression, gas loss and crystallization of magmas. While evaluating their results, they realized that something else was happening. When a crystal forms, it gives off heat. "We were actually just fussing with the samples and this sort of fell out," Cashman says. "We all of a sudden said, 'Oh my God, look at what we're seeing!'"

Like molasses, magma gets runnier as it heats up, Cashman explains. Tracking magma movement and temperature should help researchers better understand volcano-monitoring data. "Although people had theorized, 'Oh yeah, latent heating should be happening,' we were actually able to document it," says Cashman.

"I try to pose my research questions such that the findings can be used to improve both the models and ideas about how to monitor volcanoes," she adds. She and Blundy study volcanic inclusions, the pockets of melt trapped by crystals deep below Earth's surface. By examining various inclusions trapped at different times during the magma's ascent, they attempted to piece together how magma changes as it works its way to the surface.

The work relied on 25 years' worth of samples from Mount St Helens in Washington and additional samples collected over a period of five years from the Kamchatka Peninsula, a volcanic hotbed in eastern Russia. Cashman and Blundy analysed selected inclusions with an instrument known as an ion microprobe. This measures the water content and the concentration of different elements by blasting away part of the sample and running it through a mass spectrometer. By relating the inclusions to the temperatures at which they were preserved, these researchers discovered not only that a significant amount of heating occurs during this process, but that magma crystallization is a relatively fast phenomenon, taking years rather than centuries.

Although her work is of help to modellers, Cashman much prefers to be out in the field collecting samples rather than crunching numbers on a computer. One of her favourite tasks is retrieving samples from active volcanoes that are percolating (as opposed to exploding) with lava. Pieces of pasty lava roll down the side of the volcanic dome — the mound that is formed when lava is so viscous that it cannot flow out of the volcanic crater. Cashman and her colleagues run over to blocks that have rolled a safe distance from the dome, knock off a piece with a hammer, then plunge it into the nearby snow to cool.

Building on field work and geological analysis, Cashman and Blundy continue to dissect the finer points of magma and eruptions. They now plan to investigate how the ascent, degassing and crystallization of these small 'packets' of magma vary with eruption style — why magma travels quickly or slowly and what makes it explode through the surface or form a dome. They want to know, says Cashman, not only what makes magma come to the surface but what keeps it coming. ■

KEY COLLABORATORS

In 1994, two Boston College chemists with neighbouring offices discussed their respective scientific frustrations. Amir Hoveyda was having trouble identifying cleaner, more efficient catalysts in a timely manner, and Marc Snapper was seeking uses for the peptides he had been studying. They soon agreed to draw on Snapper's synthesis background and Hoveyda's catalysis experience. The relationship quickly evolved. "Now, it's a pure collaboration in which two synthetic chemists go after complex problems together," says Hoveyda.

Most recently, they found a more environmentally friendly way to synthesize small molecules for therapeutic use by skipping several waste-producing steps (see page 67).

Hoveyda says the synthetic organic chemistry field has traditionally been wary of two principal investigators sharing credit on single papers. "The culture almost discourages it," he says. Early on, colleagues warned Snapper that working with a more senior researcher could hurt his career.

But their partnership has been fruitful; the two have received joint grants from the National Institutes of Health since 1997 and have published about 20 papers together. "The reason this collaboration has been so successful is that neither of us cares who gets the credit," Hoveyda adds. ■