Brain's Arteries Have a Mind of Their Own

By Greg Miller
ScienceNOW Daily News
21 January 2009

When studying the neurological basis for everything from how we deal with the loss of a loved one to why we crave certain foods, scientists have increasingly turned to functional magnetic resonance imaging (fMRI). As it's most often used, the technique measures blood oxygenation in the brain—and the assumption has always been that areas with more oxygenated blood are areas where neurons are busily firing away. But a new study suggests that's not always true, adding an unexpected wrinkle to this burgeoning field of research.

The surprising findings come from experiments with two monkeys. Neuroscientists Yevgeniy Sirotin and Aniruddha Das at Columbia University trained each monkey to monitor a tiny light in an otherwise dark room. When the light turned red, as it did at regular, predictable intervals, a monkey could earn a juice reward by fixing its gaze on the light for a few seconds. Microelectrodes placed in the primary visual cortex, the first way station for visual information in the cerebral cortex, picked up only a steady, quiet chatter of neural activity while the monkeys performed the task. (The small light provided very little visual stimulation, Das says, akin to a single star in an otherwise black sky.) But optical measurements of blood volume and oxygenation told a different story, the researchers report in tomorrow's issue of *Nature*.

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These two hemodynamic measures rose and fell in the visual cortex throughout the experiment, repeatedly peaking a few seconds before the monkey had to fix its gaze on the light. The findings indicate that the flow of oxygenated blood to a particular brain region doesn't just increase in response to neural activity but can actually anticipate an expected task, even when nearby neurons are relatively quiet, Das says. That suggests that the association between neural firing and hemodynamics isn't as close as many researchers had assumed.

Although the findings "by no means call into question the whole body of fMRI research," Das says they should cause fMRI researchers to rethink how they design and interpret their experiments. He thinks it should be possible to alter the design of most experiments so that anticipatory hemodynamic changes like the ones he and Sirotin found can be subtracted out and the focus can be kept where most researchers want it--on neural activity.

It's a "pretty astonishing" finding, says Ralph Freeman, a neuroscientist at the University of California, Berkeley. "My hunch is that this will open up a whole new area of investigation."