How the Brain Really Works

New techniques are letting researchers look at the activity of the whole brain at once

by Alison Gopnik

For the last 20 years neuroscientists have shown us compelling pictures of brain areas "lighting up" when we see or hear, love or hate, plan or act. These studies were an important first step. But they also suggested a misleadingly simple view of how the brain works. They associated specific mental abilities with specific brain areas, in much the same way that phrenology, in the 19th century, claimed to associate psychological characteristics with skull shapes.

Most people really want to understand the mind, not the brain. Why do we experience and act on the world as we do? Associating a piece of the mind with a piece of the brain does very little to answer that question. After all, for more than a century we have known that our minds are the result of the stuff between our necks and the tops of our heads. Just adding that vision is the result of stuff at the back and that planning is the result of stuff in the front, it doesn't help us understand how vision or planning work.

But new techniques are letting researchers look at the activity of the whole brain at once. What emerges is very different from the phrenological view. In fact, most brain areas multitask; they are involved in many different kinds of experiences and actions. And the brain is dynamic. It can respond differently to the same events in different times and circumstances.

A new study in Nature Neuroscience by Jack L. Gallant, Tolga Çukur and colleagues at the University of California, Berkeley, dramatically illustrates this new view. People in an fMRI scanner watched a half-hour long sequence combining very short video clips of everyday scenes. The scientists organized the video content into hundreds of categories, describing whether each segment included a plant or a building, a cat or a clock.

Then they divided the whole brain into small sections with a three-dimensional grid and recorded the activity in each section of the grid for each second. They used sophisticated statistical analyses to find the relationship between the patterns of brain activity and the content of the videos.

The twist was that the participants either looked for human beings in the videos or looked for vehicles. When they looked for humans, great swaths of the brain became a "human detector"—more sensitive to humans and less sensitive to vehicles. Looking for vehicles turned more of the brain into a "vehicle detector." And when people looked for humans their brains also became more sensitive to related objects, like cats and plants. When they looked for vehicles, their brains became more sensitive to clocks and buildings as well.

In fact, the response patterns of most brain areas changed when people changed the focus of their attention. Something as ineffable as where you focus your attention can make your whole brain work differently.

People often assume that knowing about the brain is all that you need to explain how the mind works, so that neuroscience will replace psychology. That may account for the curious popular enthusiasm for the phrenological "lighting up" studies. It is as if the very thought that something psychological is "in the brain" gives us a little explanatory frisson, even though we have known for at least a century that everything psychological is "in the brain" in some sense. But it would be just as accurate to say that knowing about the mind explains how the brain works.

The new, more dynamic picture of the brain makes psychology even more crucial. The researchers could only explain the very complex pattern of brain activity by relating it to what they knew about categorization and attention. In the same way, knowing the activity of every wire on every chip in my computer wouldn't tell me much if I didn't also know the program my machine was running.

Neuroscience may be sexier than psychology right now, and it certainly has a lot more money and celebrity. But they really cannot get along without each other.