Resting brain reveals connections

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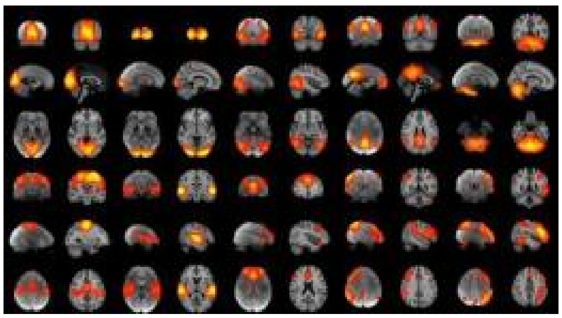

(PhysOrg.com) -- Images of the brain with various areas 'lighting up' in a rainbow of colours are now pretty familiar to many of us. These come from studies in which people are given tasks to do inside MRI scanners, and the areas that light up show where there is increased brain activity as a result. And 'functional' MRI [fMRI] has been incredibly successful in revealing the way the brain is organised.

But this approach of mapping tasks onto different areas of the brain is always going to be constrained by the experiment design and the task set, prior assumptions about what you hope to test for, and what you set out to see.

This is the reason why researchers are now looking to a new technique called resting-state fMRI, which gets rid of any of the constraints or assumptions of task-based fMRI.

Resting-state fMRI is just as it sounds. People are asked to do precisely *nothing* in the scanner - just rest for 5 minutes or so. Yet the results consistently and reliably show connections between areas of the brain that are working together in networks. The result is a map of the functioning brain.

Oxford researchers at the Centre for Functional Magnetic Resonance Imaging of the Brain (FMRIB) have been at the forefront of these efforts. They are co-authors on a new paper in *PNAS* by an international group of researchers that sets out the potential of the technique.

Dr Steve Smith explains: 'If you're interested in a specific group of people or patients - say with Alzheimer's for example - you want to find any differences in brain activity that might be of interest, not just those involved in a specific task. With resting-state fMRI, you don't necessarily have to know what you're looking for.'

The group at FMRIB, led by Dr Clare Mackay and Steve Smith, has already shown the value of the technique. Last year they found differences in young people's brain activity using resting-state fMRI according to whether or not they had a gene variant that is linked to increased risk of Alzheimer's. This difference in brain activity is decades before any symptoms of the disease would be apparent.

Clare said at the time: 'We have shown that brain activity is different in people with this version of the gene decades before any memory problems might develop. We've also shown that this form of fMRI, where people just lie in the scanner doing nothing, is sensitive enough to pick up these changes. These are exciting first steps towards a tantalising prospect: a simple test that will be able to distinguish who will go on to develop Alzheimer's.'

As well as the potential clinical relevance of this form of brain scanning, the hope is that resting-state fMRI could connect differences in people's brain activity with factors like age, sex, genes, behaviour, or disease progression.

Another great advantage of resting-state fMRI is that everyone will be conducting their experiments in the same way. This means that data can be combined from groups all over the world to map out the functioning networks in the brain - essentially giving the complete wiring diagram of the brain.

This is what the new paper by the international collaboration set out in *PNAS* this week. They show how it is possible to combine data from over 1000 volunteers collected at 35 different centres across the world (including Oxford). With all the data, they show they find the same patterns of networks functioning in the brain and are able to begin to see differences between different groups of people by age and by sex.

The PNAS paper compares this approach to genomics. Indeed, the maps produced of connections in the brain are being called the 'connectome' in the same way that the genome is the map of all our genes.

Steve Smith does see the analogy with genomics, suggesting that mapping out the connections which determine how our brains work is similar in concept to decoding our genes to discover how our body works. And there is also the similarity in approach - big international consortiums gathering data to pinpoint variation between people to gain more understanding about disease.

However, he points out that the resolution of MRI still needs to be improved. With genomics, everyone reads out directly the same fundamental chemical DNA sequence but, with MRI scans, there is still a distance between what is seen in MRI signals and the individual neural circuits that are active in the brain.

More information: Paper: www.pnas.org/content/early/201 … /0911855107.abstract

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