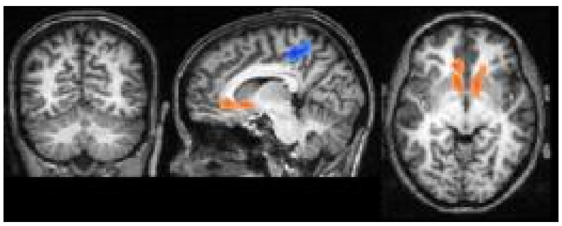
The network in our heads: What our brains have in common with the internet

May 27 2010



Comparison of the eigenvector centrality values of sated and hungry subjects. This new method of analysis is the first to enable researchers to demonstrate that, in subjects in a state of satiety, reward centres in the brain (ventral striatum) are especially strongly activated. A full stomach is seen by the brain as a "reward" (orange = high centrality in a state of satiety; blue = high centrality in a state of hunger).

(PhysOrg.com) -- Our brain works as a set of networks - much like the internet. Could our understanding of the internet help us in understanding our brains? Gabriele Lohmann and her colleagues from the Max Planck Institute for Human Cognitive and Brain Sciences in Leipzig, Germany, have now developed a method for utilizing techniques known from internet search engines to analyze fMRI data of the human brain. Using this new method, they compared hungry versus sated subjects and found that subjects seem to feel "rewarded" when they are sated.

It is common knowledge that our brains are busy even when we are not performing some appointed task. Recently, the technique of functional magnetic resonance imaging (fMRI) has been used to explore this ceaseless activity. However, when there are no external clues as to what goes on inside our brains, it is hard to make much sense of the activity that fMRI records. This arises when, for example, the experimental subject is not given a task to complete, but instead is merely hungry rather than sated while being scanned.

MRI is frequently used when neurologists wish to find out about brain activity in particular regions. MRI scanners measure the oxygen level in the blood in the brain. This allows conclusions to be drawn about the activity of individual brain regions. In experiments in which subjects have to complete tasks, the analysis is relatively simple. The oxygen levels in the blood are measured while the subject performs various tasks.

Afterwards, the results are compared. Significant differences in blood levels indicate that this brain region is responsible for completing the task selected. However, there is a question of what to do when the task is simply to take part in the experiment when in a state of hunger or satiety.

In this case, the fact that the brain - just like the internet - is a network with “small world properties” helps. Every pixel in the brain and every Internet page can be seen as a hub in this network. The hubs can be directly connected to each other just as two Internet pages can be linked.

With eigenvector centrality, the hubs are assessed based on the type and quality of their connections to other hubs. On the one hand, it is important how many connections a particular node has, and on the other, the connections of the neighbouring nodes are also significant. Search engines like Google use this principle, meaning that Internet sites linked to frequently visited sites, like Wikipedia, for example, appear higher in results than web pages which don’t have good connections.

“The advantages of analyzing fMRI results with eigenvector centrality are obvious,” says Gabriele Lohmann from the Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig. The method views the connections of the brain regions collectively and is computationally efficient. Therefore, it is ideal for detecting brain activity reflecting the states that subjects are in.

More information: G. Lohmann, D. S. Margulies, A. Horstmann, B. Pleger, J. Lepsien, et al. Eigenvector Centrality Mapping for Analyzing Connectivity Patterns in fMRI Data of the Human Brain PLoS ONE 5(4): e10232. doi:10.1371/journal.pone.0010232 (April 27, 2010)

Provided by Max-Planck-Gesellschaft