

# Research shows brain hub activity different in coma patients

November 27 2012, by Bob Yirka

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Credit: National Institute of Mental Health

(Medical Xpress)—A team of French and British researchers has found that brain region activity for coma patients is markedly different than for healthy people. In their paper published in the *Proceedings of the National Academy of Sciences*, the group describes the differences found when comparing fMRI scans of people in a coma with healthy volunteers.

To gain a better understanding of what goes on in the brain when a person is in a coma, and perhaps the nature of consciousness, the researchers performed fMRI brain scans on 17 people who had recently become comatose due to [medical conditions](#) that led to blockage of oxygen to the brain. They then compared those scans to those taken of 20 healthy volunteers.

In analyzing the results the team found that global comparisons between

the two groups revealed very few if any differences. Blood continued to flow to all of the [parts of the brain](#). When focusing on the brain as a network however, they found very large differences.

To look at the brain as a network requires looking at its different parts as regions that communicate with one another, forming hubs. In healthy people, certain regions or hubs are busier than others as evidenced by more [blood flow](#). But for the people in a coma, the team found, the normally busy hubs grew less busy, while other hubs grew busier, indicating a major change in the flow of information.

The researchers suggest that the brain scans reveal that the normally busy hubs in healthy people are centers of consciousness and their reduced role in communications in comatose patients suggests that they are most likely not conscious of their existence. They point to prior research that has suggested that being in a coma is more likely closer to the experience of being under anesthesia than being asleep. They add that their research indicates that regions of the brain that are responsible for [consciousness](#) thought likely require more oxygen rich blood, and are thus likely to be more sensitive to oxygen deprivation than other areas of the brain, which might explain why people go into a coma when those regions are harmed.

**More information:** Hubs of brain functional networks are radically reorganized in comatose patients, *PNAS*, Published online before print November 26, 2012, [doi: 10.1073/pnas.1208933109](https://doi.org/10.1073/pnas.1208933109)

## Abstract

Human brain networks have topological properties in common with many other complex systems, prompting the following question: what aspects of brain network organization are critical for distinctive functional properties of the brain, such as consciousness? To address this question, we used graph theoretical methods to explore brain network

topology in resting state functional MRI data acquired from 17 patients with severely impaired consciousness and 20 healthy volunteers. We found that many global network properties were conserved in comatose patients. Specifically, there was no significant abnormality of global efficiency, clustering, small-worldness, modularity, or degree distribution in the patient group. However, in every patient, we found evidence for a radical reorganization of high degree or highly efficient "hub" nodes. Cortical regions that were hubs of healthy brain networks had typically become nonhubs of comatose brain networks and vice versa. These results indicate that global topological properties of complex brain networks may be homeostatically conserved under extremely different clinical conditions and that consciousness likely depends on the anatomical location of hub nodes in human brain networks.

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