

Study shows differences in brain activity of humans and macaques engaged in the same task

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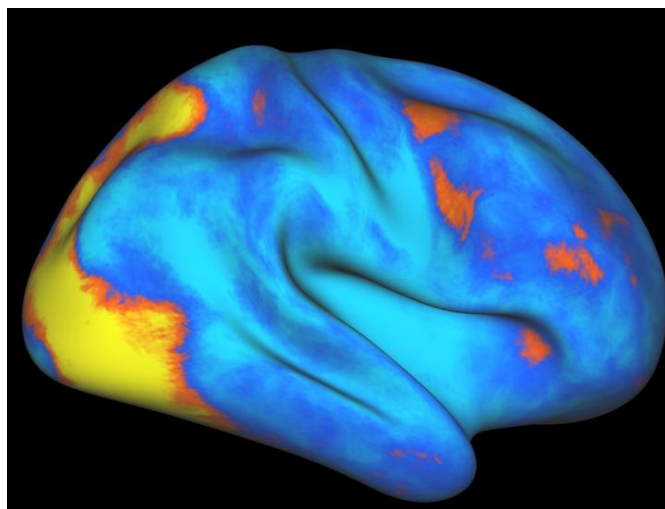
Barbary macaques. Credit: Wikipedia/Flickr/Karyn Sig

(Phys.org)—A group of researchers with affiliations to several institutions in the U.S. has identified some of the ways the human brain differs in the way it focuses on a task as compared to macaques. In their paper published in *Proceedings of the National Academy of Sciences*, the researchers detail experiments they carried out with both humans and macaques using fMRI scans.

In trying to better understand how it is the [human brain](#) works, scientists sometimes use macaques as stand-ins—that is because sometimes the experiments conducted cannot be performed on humans. One problem with this approach is that it is still not clear just how alike the brains of humans and macaques actually are. To learn more, the group conducted experiments that looked into which parts of the brain are active in both species engaged in the same task.

The experiments consisted of putting eight human beings and two macaques in an fMRI machine while they engaged in the same task and watching which parts of the brain lit up. The task consisted of staring at a single point on a computer screen while objects were displayed near the single point and pressing a button when a certain image appeared. All the volunteers were trained on the task prior to being put into the fMRI machine.

In analyzing the results the researchers discovered that the temporoparietal junction was much more active in the humans—they also noted that some other areas of the brain were more active as well. Furthermore, they discovered that there was more communication going on between the two [brain hemispheres](#). In looking at all the differences taken together, the researchers conclude that humans have a more advanced attention control network, which they note, makes sense, because we humans need to filter information more than [macaques](#)—the monkeys, presumably, must be able to react to dangerous situations much more quickly than us.



Pictured are the increases (orange-yellow) and decreases (blue) of neural activity in the brains of humans and macaques while performing the same attention task as measured by functional magnetic resonance imaging. In this study, the researchers found that the attention networks in humans fundamentally differ from those of macaques in three ways: the networks contain more areas, more information is shared between brain hemispheres, and humans possess an entire attention control network that is missing from macaques. The results suggest that the attention network has evolved to support uniquely human cognitive functions. Credit: Image courtesy of Gaurav Patel/New York State Psychiatric Institute/Columbia University Medical Center

As part of the experiment, one assumption has been that the macaque brain is likely very similar to the brain early humans had when the last common ancestors of the two species branched off in different directions. This means that the team was free to suggest that the differences they saw in the [brain](#) scans, likely indicate evolutionary changes that have occurred to our brains over the past 25 million years.

More information: Functional evolution of new and expanded attention networks in humans, Gaurav H. Patel, *Proceedings of the National Academy of Sciences*, [DOI: 10.1073/pnas.1420395112](https://doi.org/10.1073/pnas.1420395112)

Abstract

Macaques are often used as a model system for invasive investigations of the neural substrates of cognition. However, 25 million years of evolution separate humans and macaques from their last common ancestor, and this has likely substantially impacted the function of the cortical networks underlying cognitive processes, such as attention. We examined the homology of frontoparietal networks underlying attention by comparing functional MRI data from macaques and humans performing the same visual search task. Although there are broad similarities, we found fundamental differences between the species. First, humans have more dorsal attention network areas than macaques, indicating that in the course of evolution the human attention system has expanded compared with macaques. Second, potentially

homologous areas in the dorsal attention network have markedly different biases toward representing the contralateral hemifield, indicating that the underlying neural architecture of these areas may differ in the most basic of properties, such as receptive field distribution. Third, despite clear evidence of the temporoparietal junction node of the ventral attention network in humans as elicited by this visual search task, we did not find functional evidence of a temporoparietal junction in macaques. None of these differences were the result of differences in training, experimental power, or anatomical variability between the two species. The results of this study indicate that macaque data should be applied to human models of cognition cautiously, and demonstrate how evolution may shape cortical networks.

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