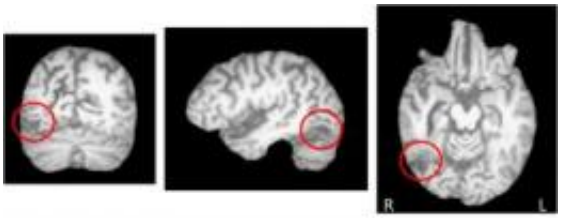
Neuroscientists uncover neural mechanisms of object recognition

July 13 2011



Certain brain injuries can cause people to lose the ability to visually recognize objects -- for example, confusing a harmonica for a cash register. Neuroscientists from Carnegie Mellon University and Princeton University examined the brain of a person with object agnosia, a deficit in the ability to recognize objects that does not include damage to the eyes or a general loss in intelligence, and have uncovered the neural mechanisms of object recognition. The results, published by Cell Press in the July 15th issue of the journal Neuron, describe the functional neuroanatomy of object agnosia and suggest that damage to the part of the brain critical for object recognition can have a widespread impact on remote parts of the cortex. These findings will force researchers to rethink basic assumptions of visual neuroscience. Credit: Carnegie Mellon University and Princeton University

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in the ability to recognize objects that does not include damage to the eyes or a general loss in intelligence, and have uncovered the neural mechanisms of object recognition. The results, published by Cell Press in the July 15th issue of the journal *Neuron*, describe the functional neuroanatomy of object agnosia and suggest that damage to the part of the brain critical for object recognition can have a widespread impact on remote parts of the cortex.

"One of the persisting controversies in the field of visual neuroscience concerns the regions of cortex that subserve the human ability to recognize objects as efficiently and accurately as we do, and it's been an elusive topic until now," said Marlene Behrmann, professor of psychology at CMU and a renowned expert in using brain imaging to study the visual perception system.

To gain new insight into the neural basis of object recognition, the research team used neuroimaging and behavioral investigations to study visual and object-selective responses in the cortex of healthy controls and a participant called SM who, following selective brain damage to the right hemisphere of the brain, exhibited object agnosia.

The researchers discovered that the functional organization of the "lower" visual cortex, where the image from the retina is initially processed, was similar in SM and control subjects. However, SM exhibited decreased object-selective responses in the brain tissue in and around the brain lesion, and in more distant cortical areas that are also known to be involved in object recognition. Unexpectedly, the decrease in object-selective responses was also observed in corresponding locations of SM's structurally intact left hemisphere.

"What was perhaps the most dramatic, controversial and counter-intuitive result was that while the lesion was in the right hemisphere, and quite small, we found that the same region in the left hemisphere was

also not operating normally," Behrmann said.

She added, "These results will force us in the field to step back a little and rethink the way we understand the relationship between brain and behavior. We now need to take into account that there are multiple parts of the brain that underlie object recognition, and damage to any one of those parts can essentially impair or decrease the ability to normally recognize objects."

Additionally, the researchers found that an area of the brain called the right lateral fusiform gyrus is vital for object recognition. There also appeared to be some functional reorganization in intact regions of SM's damaged right hemisphere, suggesting that neural plasticity is possible even when the brain is damaged in adulthood.

"To our knowledge, this study constitutes the most extensive functional analysis of the neural substrate underlying object agnosia and offers powerful evidence concerning the neural representations mediating object perception in normal vision," said Christina Konen, a postdoctoral fellow at Princeton and lead author of the study.

Provided by Carnegie Mellon University