Visual working memory not as specialized in the brain as visual encoding, study finds

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Researchers have long known that specific parts of the brain activate when people view particular images. For example, a region called the fusiform face area turns on when the eyes glance at faces, and another region called the parahippocampal place area does the same when a person looks at scenes or buildings. However, it's been unknown whether such specialization also exists for visual working memory, a category of memory that allows the brain to temporarily store and manipulate visual information for immediate tasks. Now, scientists have found evidence that visual working memory follows a more general pattern of brain activity than what researchers have shown with initial visual activity, instead activating a more diffuse area in the front of the brain for all categories of visual stimuli.

The study is entitled "Mapping Brain Activation and Information During Category-Specific Visual Working Memory." It appears in the Articles in PresS section of the Journal of Neurophysiology, published by the American Physiological Society.

Methodology

The researchers worked with 18 healthy adults with normal or corrected vision. Using functional MRI (fMRI), a technique that examines brain activity while subjects are actively performing tasks in an MRI scanner, the researchers had each volunteer view and memorize three sequentially presented images that represented one of four categories: faces, bodies, scenes, or flowers. Between each image, there was a one second delay. Then, after a 10 second delay, the researchers flashed an image from the same category and asked the volunteers to indicate through a button press whether this last image matched one of the previous pictures (half of these "test" images matched one of the previous pictures). The volunteers did 80 of these trials, 20 of each category. To help make sure they weren't verbally memorizing what they were seeing, which might change the fMRI results, a radio news program ran continuously in the background during the task. Afterwards, the researchers analyzed the fMRI data, looking for which brain areas activated during the short delay between pictures (brain areas active in initial visual activity and encoding) and during the long delay (brain areas active during working memory).

Results

The fMRI data showed that the brain areas previously shown to activate during visualization, all located near the rear of the brain, declined in activity during the 10 second delay, although subtle differences between categories could still be extracted from the data. However, different areas near the front of the brain-specifically, the bilateral ventrolateral prefrontal cortex, dorsolateral prefrontal cortex and medial frontal gyrus-became active during the long delay. These areas activated without regard to what type of visual stimulus the volunteers saw, suggesting they activate in a more general pattern for visual working memory with no particular specialization based on image category.

Importance of the Findings

Humans have a remarkable ability to store visual information at high detail over short periods of time. During these storage periods, some of the brain activity seems to shift from visual areas in the rear of the brain to areas in the front that have been suggested to form part of the brain's "control center." These areas do not appear to be specific for particular types of visual information. "We conclude that principles of cortical activation differ between encoding and maintenance of visual material," the authors say. Their findings provide support for current models that locate memory not in specific brain modules but in the concerted action of distributed networks in the brain.

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