Memory loss in older adults due to distractions, not inability to focus

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The short-term memory problems that accompany normal aging are associated with an inability to filter out surrounding distractions, not problems with focusing attention, according to a study by researchers at the University of California, Berkeley.

Although older patients often report difficulty tuning out distractions, this is the first hard evidence from functional magnetic resonance imaging (fMRI) studies of the brain that memory failure owes more to interference from irrelevant information than to an inability to focus on relevant information.

"Difficulty filtering out distractions impacts a wide range of daily life activities, such as driving, social interactions and reading, and can greatly affect quality of life," said study leader Dr. Adam Gazzaley, adjunct assistant professor of neuroscience at UC Berkeley and a newly appointed assistant professor of neurology and physiology at UC San Francisco.

"These results reveal that efficiently focusing on relevant information is not enough to ensure successful memory," he said. "It is also necessary to filter distractions. Otherwise, our capacity-limited short-term memory system will be overloaded."

The finding could mean that an inability to ignore distracting information is at the heart of many cognitive problems accompanying aging, Gazzaley said, and suggests that drugs targeting that problem may

be more effective at improving memory than drugs that improve focusing ability. He now is exploring the therapeutic role of different medications - including one of the main drugs to treat Alzheimer's disease - in older individuals with suppression deficits.

Because Gazzaley and his colleagues have identified areas of the brain that are markers for focusing and ignoring visual information, fMRI may be a good tool for assessing the value of therapies designed to improve memory and for diagnosing attention and memory problems in young and old, ranging from attention deficit disorder to dementia.

"Is this a unifying mechanism that can account for broader problems regarding attention and memory?" asked coauthor Dr. Mark D'Esposito, UC Berkeley professor of neuroscience and psychology and director of the campus's Henry Wheeler Brain Imaging Center. "I think it explains a lot of it. If you are unable to block out distracting information, you can't really attend to what you are supposed to attend to, you can't get in what you are supposed to remember, and you have a hard time retrieving what you are supposed to remember. Rather than think of it as someone having an attention problem and a memory problem, you can just think of it as someone having one problem - the inability to filter out distracting information - that's affecting other domains such as attention and memory."

Gazzaley, D'Esposito, research assistant Jeffrey W. Cooney and graduate student Jesse Rissman will report their findings in the journal Nature Neuroscience, to be published online Sept. 11.

Gazzaley and his colleagues compared young adults aged 19 to 30 with older adults aged 60 to 77 using a simple memory test that introduced irrelevant information. The tests were conducted while subjects' heads were inside a fMRI scanner so that activity in the brain could be pinpointed.

While young subjects were easily able to suppress brain activity in areas that process information irrelevant to the memory task, older adults on average were unable to suppress such distracting information. Both groups were equally able to enhance brain activity in the areas dealing with information relevant to the task.

Interestingly, six of the 16 older adults had well-preserved short-term memory and no problems ignoring irrelevant information, suggesting that some people are able to avoid memory loss as they age. Gazzaley hopes to find out what makes these people different from the average aging adult.

"Encouragingly, a subgroup of the older population does not experience this suppression deficit and accompanying memory impairment, opening the road for studies of successful aging," Gazzaley said.

Gazzaley, a neurologist who specializes in treating mild cognitive impairment common in older adults, set out to see how attention affects short term or "working" memory. He developed a test to distinguish two aspects of attention: the brain's ability to focus on a visual stimulus, and the ability to suppress or ignore other visual information. He noted that both involve brain activity in the higher level neocortex, acting on the visual cortex - a process he refers to as "top-down modulation."

The test involves presenting a sequence of four images, two of them faces and two natural scenes. Subjects were asked to remember either faces, in which case the scenes were irrelevant information; or scenes, in which case faces were irrelevant. Subjects then were asked whether a particular face or scene appeared among the four images. In a separate test, subjects were asked only to observe the stimuli without attempting to remember them.

After first identifying with the fMRI the regions in the brain attentive to

faces and scenes (they differ slightly in each individual), Gazzaley presented his subjects with the three tests and recorded brain images in each case.

When asked to remember faces, young adults showed enhanced activity in the brain area dealing with faces and decreased activity in the area dealing with scenes (the parahippocampal/lingual gyrus). Similarly, when asked to remember scenes, they showed enhanced activity in the scene area of the brain and suppressed activity in the area dealing with faces.

Older adults, however, while showing comparable enhancement of the face area when asked to concentrate on faces, exhibited poor or no suppression of the scene area, and vice versa.

"These data suggest that older individuals are able to focus on pertinent information, but are overwhelmed by interference from failing to ignore distracting information, resulting in memory impairment," the authors wrote.

D'Esposito said that the technique Gazzaley developed to probe focusing and ignoring ability opens the door to numerous experiments that could shed light on a popular theory today - that problems of aging have to do with a decline in the brain's frontal lobe.

"The frontal lobes are the highest level of cognition and the area that integrates information from all over the brain," he said. "If you look at the frontal lobes over time, that is the area where there is more decline than any other part of the brain."

To shed light on this hypothesis, Gazzaley and D'Esposito plan to look at patients with known or presumed frontal lobe damage, to see if they also have problems with focusing or ignoring. Also, they plan to look at people with attention deficit disorder, addiction problems, and mild

cognitive impairment in search of evidence that these problems too are due to dysfunction of the frontal lobe.

"There may be unknown lesions in the frontal lobe that affect attention," Gazzaley said. "Aging is not a disease, but I think there likely is a problem with top-down control that could be fixed with drugs."

"If aging is a frontal lobe dysfunction, it is a mild form of it," D'Esposito said. "And if we learn something about it, then we may be able to help and know more about patient populations that have a more severe form of frontal lobe damage, like traumatic brain injury and strokes and dementia."

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