Age-related memory loss tied to slip in filtering information quickly

September 2 2008

Scientists have identified a way in which the brain's ability to process information diminishes with age, and shown that this break down contributes to the decreased ability to form memories that is associated with normal aging.

The finding, reported in the current online early edition of *Proceedings of the National Academy of Sciences*, fuels the researchers' efforts, they say, to explore strategies for enhancing brain function in the healthy aging population, through mental training exercises and pharmaceutical treatments.

The research, conducted by University of California, San Francisco and University of California, Berkeley scientists, builds on the team's seminal 2005 discovery ("Nature Neuroscience," October 2005) that the brain's capacity to ignore irrelevant information diminishes with age.

The capacity to ignore irrelevant information -- such as most of the faces in a crowded room when one is looking for a long-lost friend – and to enhance pertinent information -- such as the face of a new acquaintance met during the search for the old friend – is key to memory formation. This process is known as top-down modulation.

In the 2005 study, the team recorded brain activity in younger and older adults given a visual memory test in which they were shown sequences of images (sets of two faces and two scenes), told to remember a specific category, and then asked to identify an image from that category nine

seconds later. The scientists, using functional magnetic resonance imaging (fMRI), determined that the neurons of the older participants (ages 60 to 72) responded excessively to the images they should have ignored, compared to the younger adults (ages 19 to 33). This attention to the distracting information directly correlated with how well the participants did on the memory test.

In the current study, the team used electroencephalography (EEG), which measures the speed of neural processing, to examine the relationship between this inhibitory deficit hypothesis of normal aging and another leading hypothesis – that the brain's ability to process information quickly, diminishes. According to this theory, if information is not moving quickly onto the brain's conveyor belt, of sorts, there will be a backup of data, and this, in turn, will delay later information processing that will disrupt memory formation.

The new study, involving the same visual memory test used in the previous research, revealed that both brain processes – the capacity to ignore irrelevant information and the ability to process information quickly -- diminished with age and, in fact, worked in tandem. The participants had trouble suppressing unnecessary information, but only because the speed with which they processed the irrelevant data decreased. Significantly, the slow down in processing time happened only in the very early stages of visual processing -- within 200 milliseconds.

"The study showed that the brains of older adults have a deficit in suppressing irrelevant information during visual working memory encoding, but only in the first tenth to two tenths of a second of visual processing," says the lead author of the study, Adam Gazzaley, MD, PhD, assistant professor of neurology, a member of the UCSF Memory and Aging Center and director of the UCSF Neuroscience Imaging Center.

Moreover, despite the aging brain's ability to suppress extraneous information in the ensuing milliseconds, the memory deficit persists, implying, he says, that interference by irrelevant information apparently overwhelms a limited working memory capacity, which is the ability to hold information in mind for brief periods of time to guide your actions.

As to what causes the break down in inhibition and processing speed, scientists do not know. They do know that, in the course of aging, there are changes in the structure of neurons, the density of neural tissue and the actions of neurochemicals acting on the cells. They also know that there are changes in the neural connections between neurons in far flung parts of the brain.

In the healthy aging brain, these changes are subtle. In the brains of those with mild cognitive impairment and the more severe form of impairment, such as Alzheimer's disease, they are substantial.

The team is now trying to relate how these changes might affect changes in inhibition and processing speed.

They also are investigating strategies for remediating these changes, both mental training exercises that would improve the speed and efficiency of information processing and drugs that would inhibit the brain's attention to extraneous information.

"People's expectations for their later years have changed," says Gazzaley. "They want to remain actively engaged – to continue to work, to learn new languages, to move to countries where they can practice their new language.

"The ability to selectively focus our attention, suppress distracting input and hold relevant information in our mind defines our conscious experience and serves as a critical crossroad between attention and

memory. The people in our study are functioning well; many are still working, but they want to function at the level they did previously."

Source: University of California - San Francisco