Medical Xpress

How kids' brain structures grow as memory develops

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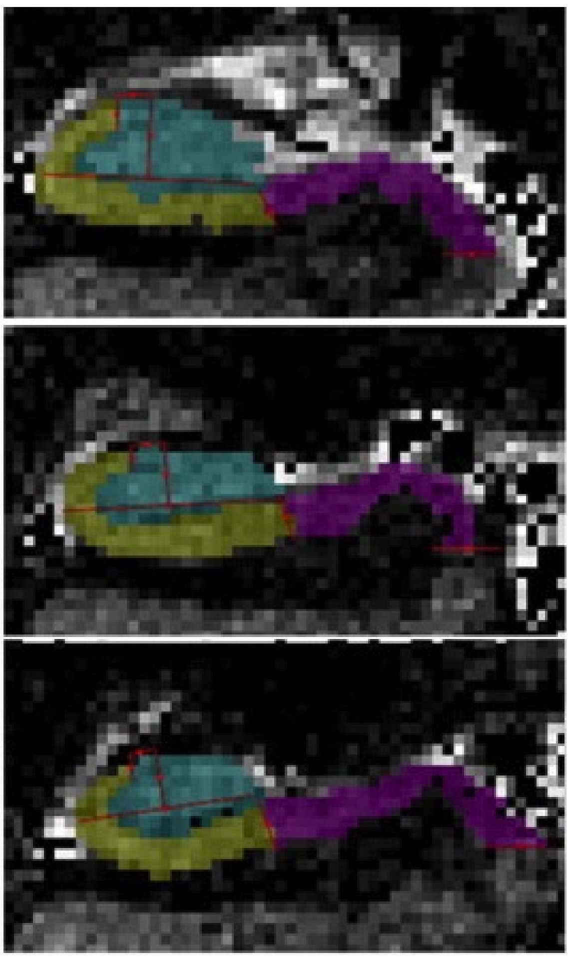


There are three slices taken by MRI through the right hippocampus of an 8-year-old. The cornu ammonis (CA) 1 is in yellow, CA3/dentate gyrus in blue and subiculum is colored purple. UC Davis researchers were able to track how these regions change in size as children enter adolescence and develop memory abilities. Credit: Simona Ghetti and Joshua Lee, UC Davis.

Our ability to store memories improves during childhood, associated with structural changes in the hippocampus and its connections with prefrontal and parietal cortices. New research from UC Davis is exploring how these brain regions develop at this crucial time. Eventually, that could give insights into disorders that typically emerge in the transition into and during adolescence and affect memory, such as schizophrenia and depression.

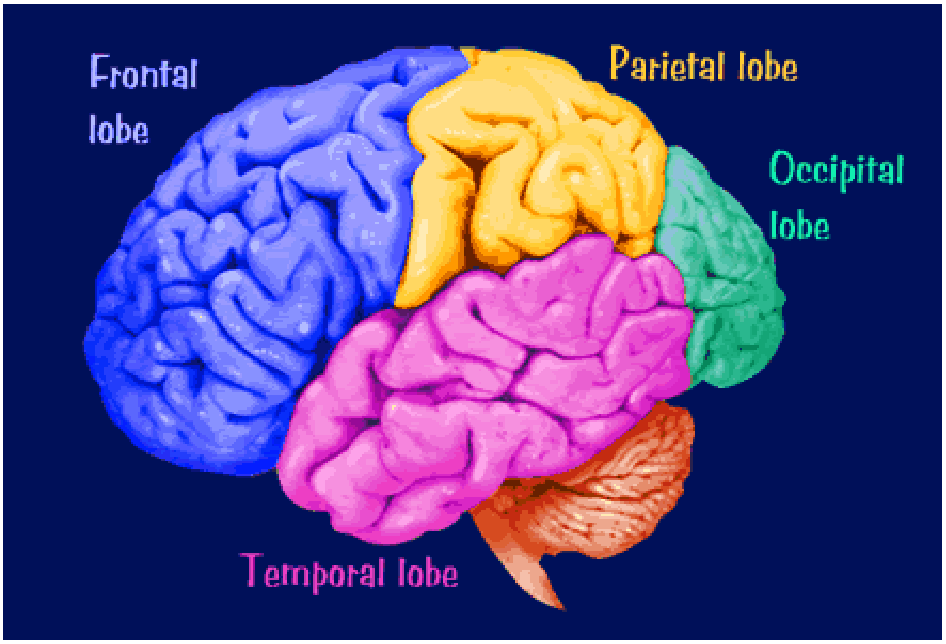
Located deep in the middle of the brain, the hippocampus plays a key role in forming memories. It looks something like two curving fingers branching forward from a common root. Each branch is a folded-over structure, with distinct areas in the upper and lower fold.

"For a long time it was assumed that the hippocampus didn't develop at all after the first couple of years of life," said Joshua Lee, a graduate student at the UC Davis Department of Psychology and Center for Mind and Brain. Improvements in memory were thought to be due entirely to changes in the brain's outer layers, or cortex, that manage attention and stretagies. But that picture has begun to change in the past five years.

Recently, Lee, Professor Simona Ghetti at the Center for Mind and Brain and Arne Ekstrom, assistant professor in the UC Davis Center for Neuroscience, used magnetic resonance imaging to map the hippocampus in 39 children aged eight to 14 years.

While subfields of the hippocampus have been mapped in adult humans and animal studies, it's the first time that they have been measured in children, Ghetti said.

"This is really important to us, because it allows us to understand the heterogeneity along the hippocampus, which has been examined in human adults and other species" Ghetti said.



The cerebral cortex manages attention. Areas are connected by white matter tracts. Credit: Mammalian Brain Collection, University of Wisconsin-Madison, funded by NSF/NIH; via brainmuseum.org.

Looking at three subregions—the cornu ammonis (CA) 1, CA3/dentate gyrus and subiculum—they found that the first two expanded with age, with the most pronounced growth in the right hippocampus. Only in the oldest 25 percent of the children, within a few months either side of 14, did the sizes of all three regions decrease.

When they tested the children for memory performance, children with a larger CA3/dentate gyrus tended to perform better, they found. The work was published online March 15 by the journal *Neuroimage*.

In a related study in collaboration with the laboratory of Professor Silvia Bunge at UC Berkeley, published March 27 in Cerebral Cortex, the researchers also demonstrated how white matter connections projecting from the hippocampus to the brain cortex are related to memory function in children.

"White matter" tracts connect the prefrontal and parietal regions of the brain cortex, which control how we pay attention to things and engage in memory strategies, with the media-temporal lobe, the area that includes the hippocampus.

In the study, children performed a memory test that prompted them either to actively memorize an item—and therefore engage the prefrontal and parietal cortices—or to view an image passively. The ability to successfully modulate attention was linked to development of white matter tracts linking the prefrontal and parietal cortex tothe mediatemporal lobe, Ghetti said, but not to fronto-parietal connections.

Lead author on the paper is UC Berkeley researcher Carter Wendelken, with coauthors Lee, Bunge and Ghetti as well as Jacqueline Pospisil, Marcos Sastre and Julia Ross, all at UC Davis. It's part of a large collaborative study of memory function and brain growth in children, lead by Ghetti and Bunge, and funded by the National Institutes of Health. The study will look at the development of in a cohort of children from age eight to 14 years.

More information: Paper: www.sciencedirect.com/science/ … ii/S1053811914001657

Provided by UC Davis