Researchers discover the anatomic reasons for the persistence of musical memory in alzheimer patients

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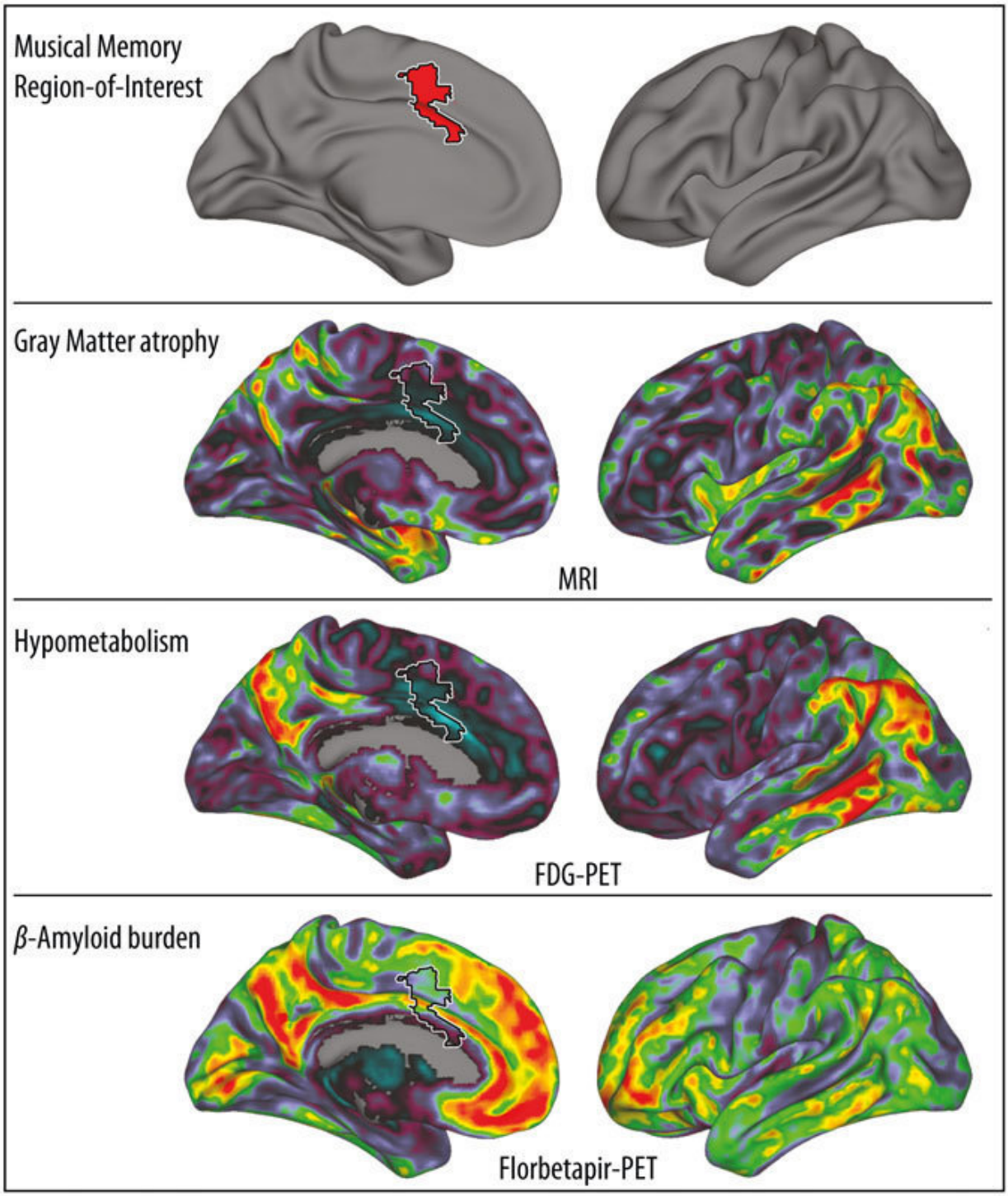

The region for musical memory (top: red, otherwise surrounded by a white border) compared with other regions of the brain of an Alzheimer's patient: areas with maximum neuronal loss (2nd row from above), decrease in metabolism (3rd row from above.) And amyloid protein aggregations (bottom row) are red, areas

with minimal changes are shown in purple (in the left and right column, the left brain is shown from different perspectives, respectively). Credit: MPI f. Human Cognitive and Brain Sciences

In comparison to other memory functions, long-term musical memory in Alzheimer patients often remains intact and functional for a surprisingly long time. However, until now, the underlying causes of this phenomenon have remained in the dark. In a recent study, scientists from the Max Planck Institute for Human Cognitive and Brain Sciences in Leipzig, the University of Amsterdam and INSERM Caen have pinpointed the location of musical memory for the first time and shown that this area of the brain remains largely intact despite progressive degeneration of the brain in Alzheimer patients.

Surprisingly, Alzheimer's often spares long-term musical memory. In practice, carers and therapists take advantage of this phenomenon to stimulate their patients with music. It is often possible for music to reactivate memories, emotions and impressions. In some cases, patients are able to sing lyrics of songs even when speaking has become almost impossible for them.

However, this phenomenon has remained scientifically unexplained. "This is the first neuroscientific study to provide an anatomic explanation for the persistence of musical memory," says Jörn-Henrik Jacobsen, scientist at the Max Planck Institute in Leipzig and the University of Amsterdam.

To shed light on the matter, the researchers first located the seat of long-term musical memory in the brain with the help of functional ultra-high-field magnetic resonance imaging. For this purpose, they ran a behavioural experiment using a set of song stimuli taken from the top 10

pop hit charts in Germany between 1977 and 2007, children's songs, oldies and well-known classical pieces. The aim was to identify melodies that the study participants were familiar with. "An individual's musical experience and musical memories are largely shaped by social and cultural circumstances. It was therefore important to avoid a subjective choice of songs and to have a group selection instead," Jacobsen explains. The chosen musical excerpts were combined with totally unknown but characteristically similar pieces of music in groups of three.

While being monitored by MRI, the subjects listened to groups of three musical samples consisting of a long-known song, a song they had just heard and a completely unknown melody. The data were then analyzed with the help of statistical pattern-recognition methods. The scientists were able to conclude from the various active brain areas which of the three categories (long-known, recently heard, unknown) the study participants had just heard. They identified a region in the supplementary motor cerebral cortex that is responsible for long-term musical memory – an area that is involved in movement. "Our study shows that the temporal lobes are not essential for musical memory, as had previously been suspected, but rather areas associated with complex motor functions," Jacobsen explains.

In a second step, the scientists compared the areas responsible for musical memory in the healthy group with anatomic findings from a study with Alzheimer patients. In the process, they considered three important features of the disease: loss of neurons, reduced metabolism and deposition of amyloid protein in the affected brain areas.

They found that the brain area that had been identified as the seat of long-term musical memory does in fact lose fewer neurons than the rest of the brain. Also, metabolism in this area does not decline as much. The extent of amyloid deposits is similar to that in other areas of the brain

but does not lead to the deficits otherwise associated with advanced stages of the disease. The brain areas responsible for long-term musical memory are therefore often affected least by neuron loss and typical metabolic disorders in Alzheimer patients.

The results of the study indicate that long-term musical memory is better preserved in Alzheimer patients than short-term memory, autobiographical long-term memory and speech. It can therefore remain largely intact even in advanced stages of the disease. "Our findings also lend support to a theory previously proposed in connection with other studies that found stronger network connections between the anterior gyrus cinguli and other nodes in Alzheimer patients. This suggests that this area of the brain also provides specific compensatory functions as the disease progresses," Jacobsen says, in explanation of the results' importance.

The scientists hope their investigations will give fresh impetus to research into the poorly understood mechanisms of long-term musical memory in Alzheimer patients. "In future, a sound understanding of the complex relationships could lead to a real therapeutic benefit of music in patient care," Jacobsen believes.

More information: "Why musical memory can be preserved in advanced Alzheimer's disease." DOI: dx.doi.org/10.1093/brain/awv135

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