Does a looser mind lead to faster learning?

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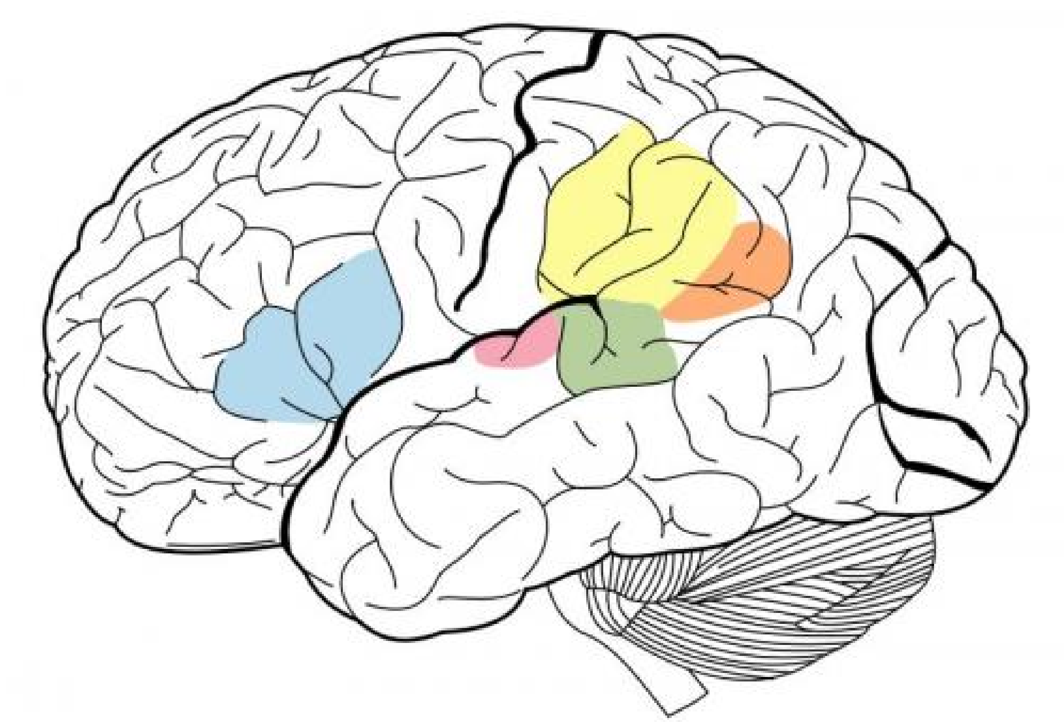

The Primary Auditory Cortex is highlighted in magenta, and has been known to interact with all areas highlighted on this neural map. Credit: Wikipedia.

You wouldn't think that dissolving part of the brain, particularly one that helps hold the organ together, would help a gerbil rethink a problem. But that's exactly what a team of German scientists has done.

Their results, published online this week in the journal *Proceedings of the National Academy of Sciences*, suggest that a lot more is going on in the spaces between neurons, and an area of the brain once thought of as a simple processor may be more like a calculator.

Researchers from the Leibniz Institute for Neurobiology in Magdeburg were focusing on a microscopic scaffold that stabilizes the synapses, the tiny gaps where electrochemical signals are relayed between neurons.

There already were clues that this so-called extracellular matrix, which comes into place as the brain matures, did much more than just hold things together. Injecting enzymes to digest this matrix seemed to put animal brains in a more youthful state where neuron pathways could be altered, previous research had shown.

But could such a change also affect cognition?

The researchers used Mongolian gerbils, whose brains are particularly enriched with this matrix. They trained the rodents to discriminate between two sounds, each associated with either escaping a shock or staying put to avoid one. Then they reversed the scenario, requiring the gerbils to re-learn the associations.

In between, they injected the matrix-eating enzyme into the auditory cortex of some of the gerbils. The injected rodents re-learned the task faster than their normal confederates. Through a series of other experiments, the researchers found that the enzyme did not affect the original learning, nor erase memory. The new behavior appeared to arise from new cognition, and it arose faster without a strong matrix.

"If you had to learn something pretty new, then, whether you remove the extracellular matrix or not has no dramatic effect," said biochemist Renato Frischknecht, principal author of the study, published Monday. "But when you really have to bring new behavioral meaning to something you learned in a different way, it seems to promote that relearning process."

The results also suggest that more is going on in the auditory cortex than might be expected. The auditory cortex isn't just passing rudimentary information to regions associated with more complex processing. It appears to be calculating.

"We strongly believe that the primary auditory cortex is doing much more than just sound analysis, but is engaged in a task-relevant manner," said Max F.K. Happel, a behavioral neuroscientist at the Leibniz Institute, and first author of the study.

"It's not just a brain area that receives input; it's doing more than that," said Frischknecht. "It's doing computation."

The results suggest that guided therapies that include ways to make the brain more open to rewiring might be able to alter memory and cognition - and perhaps be applied to stroke victims and those suffering from post-traumatic stress. Research in animals and humans has shown that alterations in this matrix also are linked with drug abuse and recovery relapse.

Early this year, a study using mice found that stimulating a gene could alter neurons and open a window of learning that could help change associations with distant memories. Last year, another study showed similar genetic tweaking could make the brains of mice more flexible and help rewire neurons.

More information: Enhanced cognitive flexibility in reversal learning induced by removal of the extracellular matrix in auditory cortex, *PNAS*, www.pnas.org/cgi/doi/10.1073/pnas.1310272111

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