Human 'language gene' makes mice smarter

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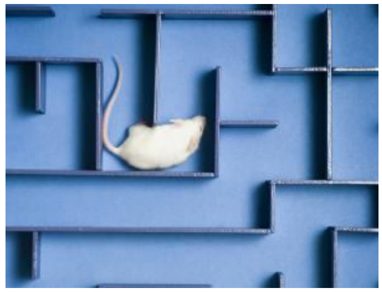
It was named the language gene before we really understood what it did. Now mice given the human version of the *FOXP2* gene are shedding light on how speech evolved in early humans.



Woah, déjà vu *(Image: Mike Kemp/Rubberball/Corbis)*

Mice with the gene seem to be better at learning to do a task automatically or unconsciously – something we do when we learn a new route to work, for example. The researchers claim that this, in conjunction with other work, suggests the *FOXP2* gene could help us learn to talk as infants by giving us unconscious control over our lips and tongue.

FOXP2 is the best-studied gene thought to have played a role in the evolution of the human brain. It was discovered in the 1990s in a British family known as KE, some of whom have severe speech difficulties caused by a mutation in this gene. *FOXP2* was found to encode a "transcription factor", a protein that regulates the activity of other genes, and to be active in the brain during embryonic development.

Humans only

Comparing the human and chimpanzee genomes revealed that since we split from chimps there have been two key historical mutations in this gene. It is thought that these mutations had a hand in our superior vocal abilities. The big question is what would happen if the human version of this gene were put into chimpanzees. Would it improve their vocal abilities, for example? We might never know, though, because ethical concerns prevent such research being done on chimps.

The human version of the gene has been put into mice, however. It alters their brains in numerous subtle ways, especially in the neural circuits involved in learning. But until now it was unclear what effects this had on behaviour or intelligence.

To find out, Ann Graybiel of the Massachusetts Institute of Technology and her colleagues tested the mice using a cross or T-shaped maze containing a food reward.

Conscious thought

The maze could be altered to test both unconscious and conscious learning processes. Sometimes the food was placed so that the animals always had to turn in the same direction to find the food, which is thought to involve automatic learning.

At other times the food was put into different arms of the maze but with visual cues to show its hiding place, which, in humans at least, requires conscious thought processes. "It's a good way of differentiating between these two modes of learning," says Faraneh Vargha-Khadem of University College London.

The mice with a human version of *FOXP2* learned to find the food faster than normal mice – eight days compared with 12 days – if the maze was set up so that they could use both conscious and automatic learning processes. There was no difference in the rate of learning if the mice had to use either strategy alone.

If you think about it, says Graybiel, this set-up is exactly what happens when humans learn a new route to work – first we go by visual cues, then it almost feels like our feet know their own way because the route becomes automatic.

The results suggest the *FOXP2* mice were better at learning to transfer behaviour from conscious to automatic control, says Graybiel. "They are superstars at this transition."

Automatic mouth

So how does this relate to the evolution of language? Speech is often seen as requiring a leap in conscious thought-processing abilities, says Graybiel, but it is also dependent on complex movements of the lips and tongue becoming automatic. *FOXP2* could have aided this transition when early humans first gained the ability to talk. If that is true, the gene would also play a role when infants are learning to speak.

Vargha-Khadem cautions, however, that the *FOXP2* gene operates in many parts of the brain and so this finding might not necessarily explain its role in speech. "You can't extrapolate too much," she says.

Either way, the mouse experiments are starting to tease apart different kinds of learning processes that are affected by the human version of *FOXP2*, says Dianne Newbury of the University of Oxford. "It's an important piece of the puzzle," she says.

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