Language-related gene responsible for branching of neurons

September 1 2011

(Medical Xpress) -- Which genetic mutations enabled the evolution of language? The foxp2 gene plays an important role in language development. Simon E. Fisher at the Max Planck Institute for Psycholinguistics in Nijmegen, Netherlands, and Sonja C. Vernes at Oxford University have discovered that this gene plays an important role in the branching of neurons in the brain during embryonic development.

The fact that humans are able to form words and sentences is due to complex neuron branches in the brain which connect words to meanings and control the mouth, tongue and larynx during articulation. The foxp2 gene influences the correct formation and functioning of these circuits. It contains the blueprint for a protein which acts as a transcription factor, regulating the transcription rates of other genes and thus influencing which proteins are produced by a cell.

The scientists were set on the trail of foxp2 by a family in East London in which a strikingly large number of family members had the same speech defect. The affected family members – all descendants of the same grandmother – have difficulty controlling the movements of their mouth and tongue and, as a result, find it difficult to communicate. They also have problems comprehending grammatical rules. Fisher and his colleagues discovered at the time that the mutation of a gene on chromosome 7 is responsible for this defect. This discovery was the beginning of intensive research on this gene segment and corresponding versions in the genetic make-up of other species. The research proved, for example, that young songbirds with a “muted” foxp2 gene are unable

to exactly reproduce their older conspecifics' songs.

In their current study, Fisher, Vernes and their colleagues were able to demonstrate for the first time how exactly transcription factor foxp2 works. Within the framework of a mass screening of the embryonic brain tissue of mice, they first researched the genetic programs downstream of foxp2, and then subsequently analysed their function inside the neurons. Not only did they find that different foxp2 activity affects the length and ramification and thus the branching of neurons in the embryonic brain, they also discovered a large number of genes that are regulated by foxp2. "Interestingly, most of these genes were known as important factors for the connections in the central nervous system", says Fisher.

With the discovery of the different genetic players, Fisher and Vernes have found exciting leads for completely new approaches in functional gene analysis of individuals with speech impediments. It is also encouraging that the scientists found that the genetic development worker on chromosome 7 is not only active during the embryonic stage, but also ensures neuronal plasticity in the adult brain.

More information: Sonja C. Vernes, Peter L. Oliver, Elizabeth Spiteri, Helen E. Lockstone, Rathi Puliyadi, Jennifer M. Taylor, Joses Ho, Cedric Mombereau, Ariel Brewer, Ernesto Lowy, Jérôme Nicod, Matthias Groszer, Dilair Baban, Natasha Sahgal, Jean-Baptiste Cazier, Jiannis Ragoussis, Kay E. Davies, Daniel H. Geschwind, Simon E. Fisher, Foxp2 Regulates Gene Networks Implicated in Neurite Outgrowth in the Developing Brain, *PloS Genetics*, 7th July 2011.

Provided by Max-Planck-Gesellschaft