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Der Präsident

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Flies can tell us about the Origin of Language

Researchers discover language gene necessary for fly learning

Scientists have discovered a crucial component of the origin of language – in fruit flies. A team at Universität Regensburg in collaboration with researchers from Berlin, Jena and Columbia, Missouri in the US studied the fruit fly version of a gene involved in human language, FOXP2, and found that it is necessary for learning movements in flies as well.

"Speaking any language requires proper articulation of the different sounds," says Björn Brembs, Professor of Neurogenetics at Universität Regensburg, who coordinated the collaboration. "To accomplish this feat, muscles in the lips, tongue and larynx need to work perfectly together. As toddlers, we acquire these skills by babbling until what we utter matches what we want to say," adds Constance Scharff who has shown the relevance of FoxP for song learning in birds at the Freie Universität Berlin. "Young songbirds try out different variants of sounds similarly to how infants babble". Brembs and Scharff's groups teamed up to study the role of FoxP in flies.

The researchers studied flies with genetically engineered FoxP in a learning experiment that comes as close to vocal learning as possible in a non-vocal animal. Similarly to infants and birds, the flies had to try out different movements with their flight muscles to learn where to fly and where not to fly. Using a heat beam, the experimenters trained the flies to avoid flying towards one direction, forcing the fly to try different steering maneuvers. Flies with compromised FoxP genes failed in this task, while control flies did well. Importantly, the FoxP manipulated flies had no problem learning to avoid a particular direction when this was coupled to a color. The specificity of this deficit is also typical for patients with FOXP2 mutations.

“Also in line with the known function of FoxP in humans and birds is the observation that the morphology of certain sub-regions of the mutant flies’ brains is altered. This indicates that FoxP might regulate the expression of other genes during brain development,” says Jürgen Rybak from the Max Planck Institute for Chemical Ecology in Jena, who performed the morphological measurements of the fly brains.

These discoveries suggest that one of the roots of language can be placed 500 million years ago at the split between vertebrates and invertebrates, to an ancestor which had evolved the ability to learn by trial and error. From this, Troy Zars of the University of Missouri, Columbia concludes, “The identification of this phenotype in FoxP mutant flies provides a starting point in understanding the genes involved in trial-and-error-based learning and communication across species, and should help in understanding how genetic bases of communication deficits arise in humans." Zars had discovered the FoxP gene in the fly genome in 2007.

“Presumably, the ability to learn from trial and error was harnessed when vocal learning in vertebrates and language acquisition in humans evolved,” Brembs surmises. The conservation of these functions opens the window for basic research into the genetic mechanisms underlying complex traits such as language or schizophrenia in animals that do not exhibit these traits – especially in genetically very accessible invertebrates such as Drosophila.

Further information:
http://brembs.net

Attachment:
Photograph of Drosophila

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