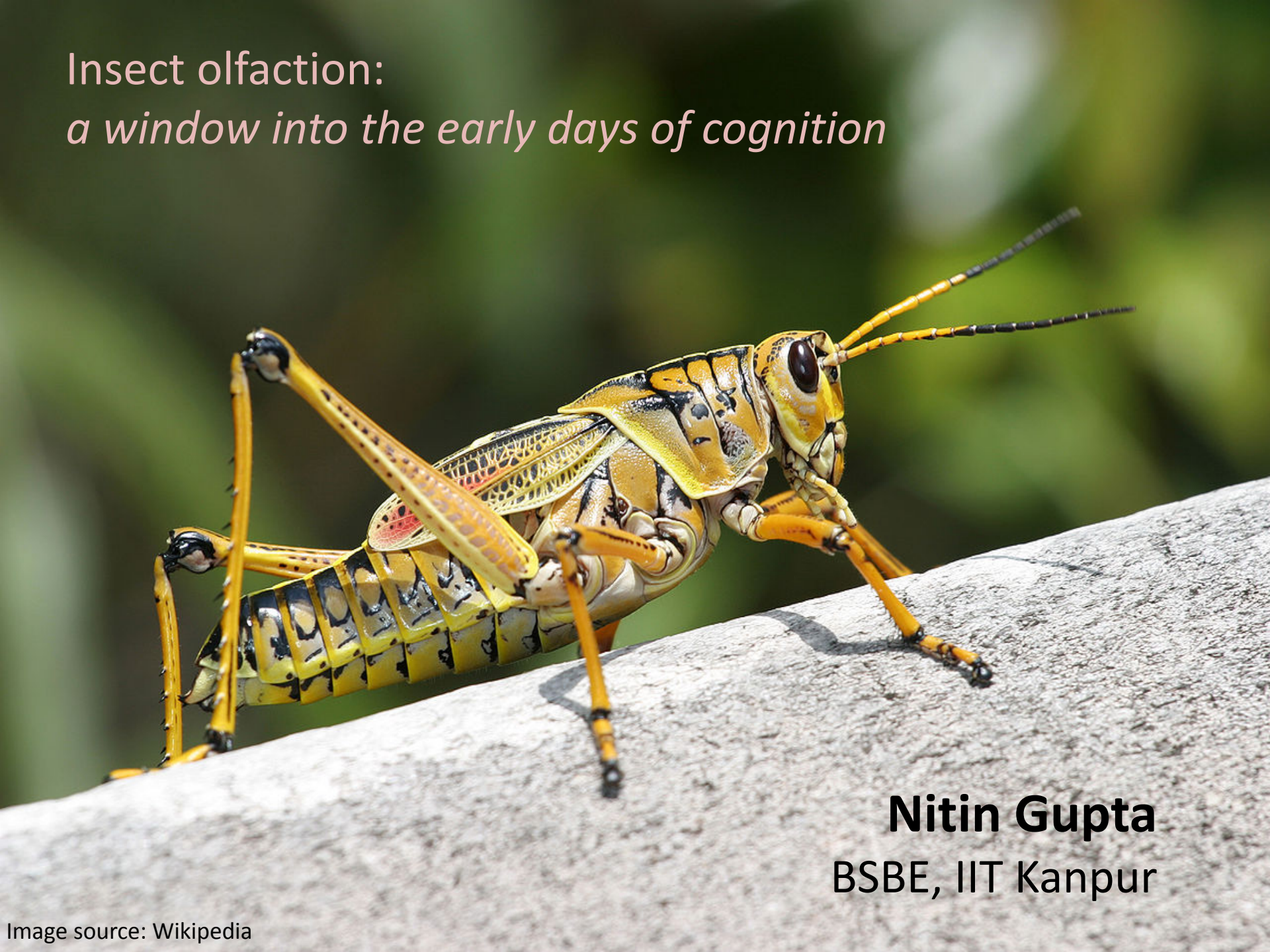
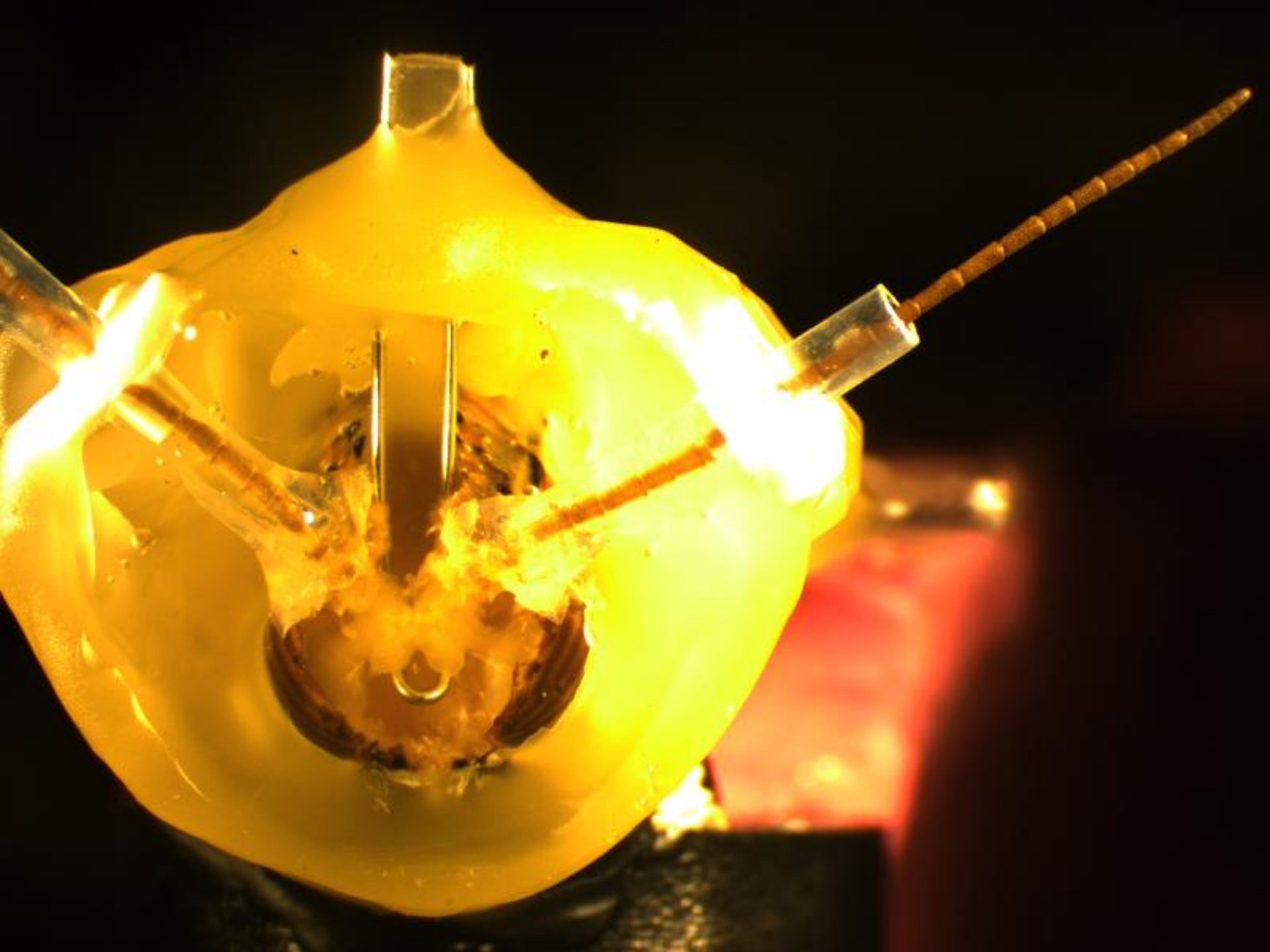
Insect olfaction:
a window into the early days of cognition

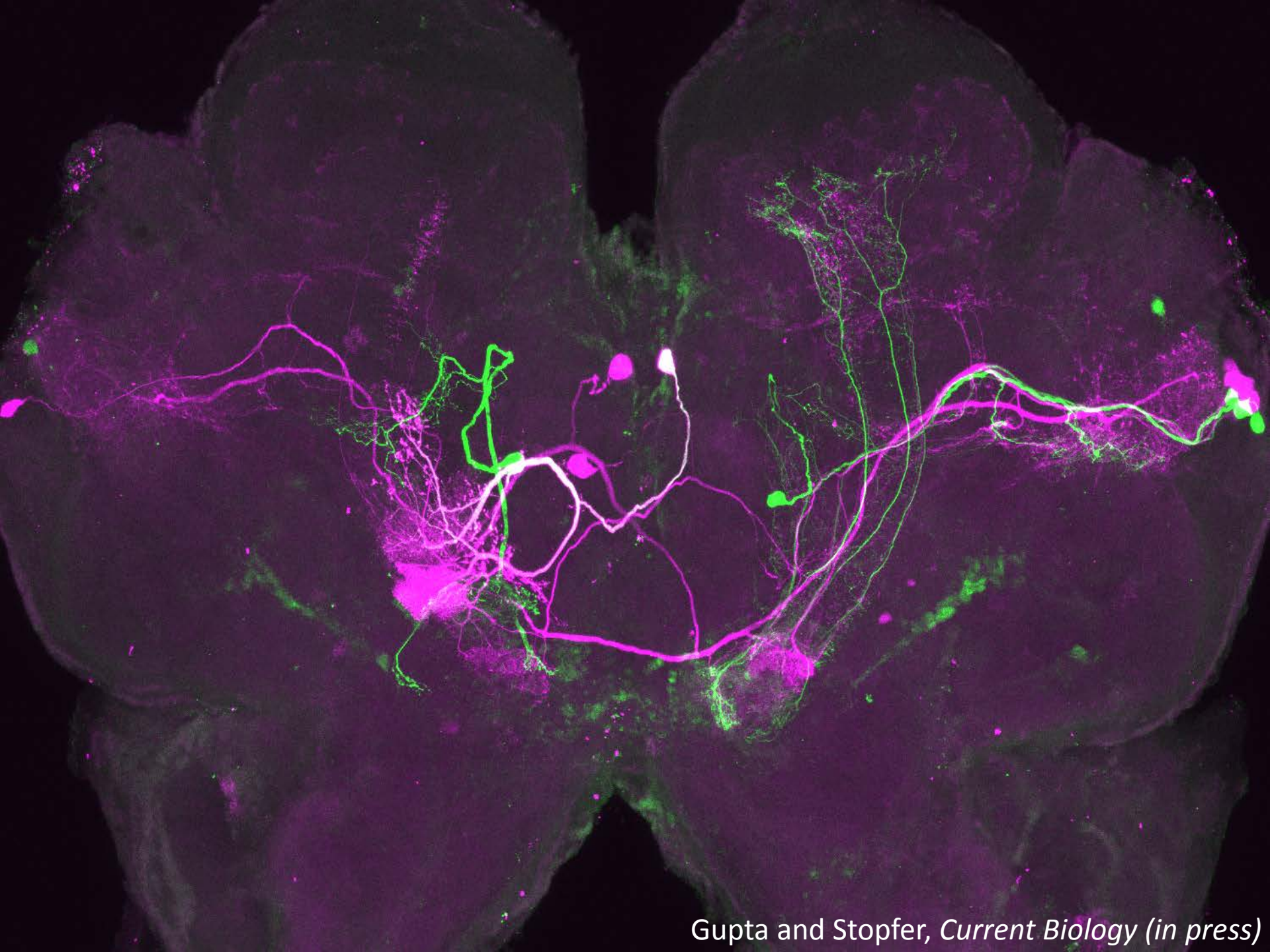


Nitin Gupta
BSBE, IIT Kanpur

Image source: Wikipedia

Insects have brains.





Gupta and Stopfer, *Current Biology (in press)*

Insect Brain	Human Brain
Size of a sand grain	Size of a cabbage
~1000,000 neurons	~100,000,000,000 neurons

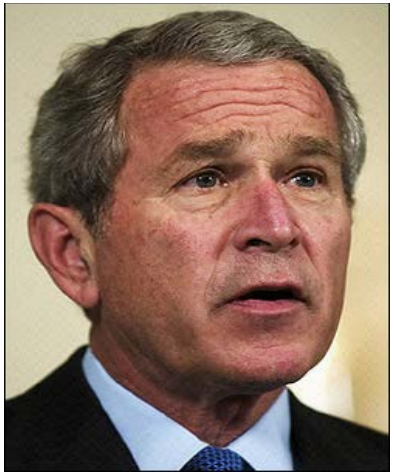
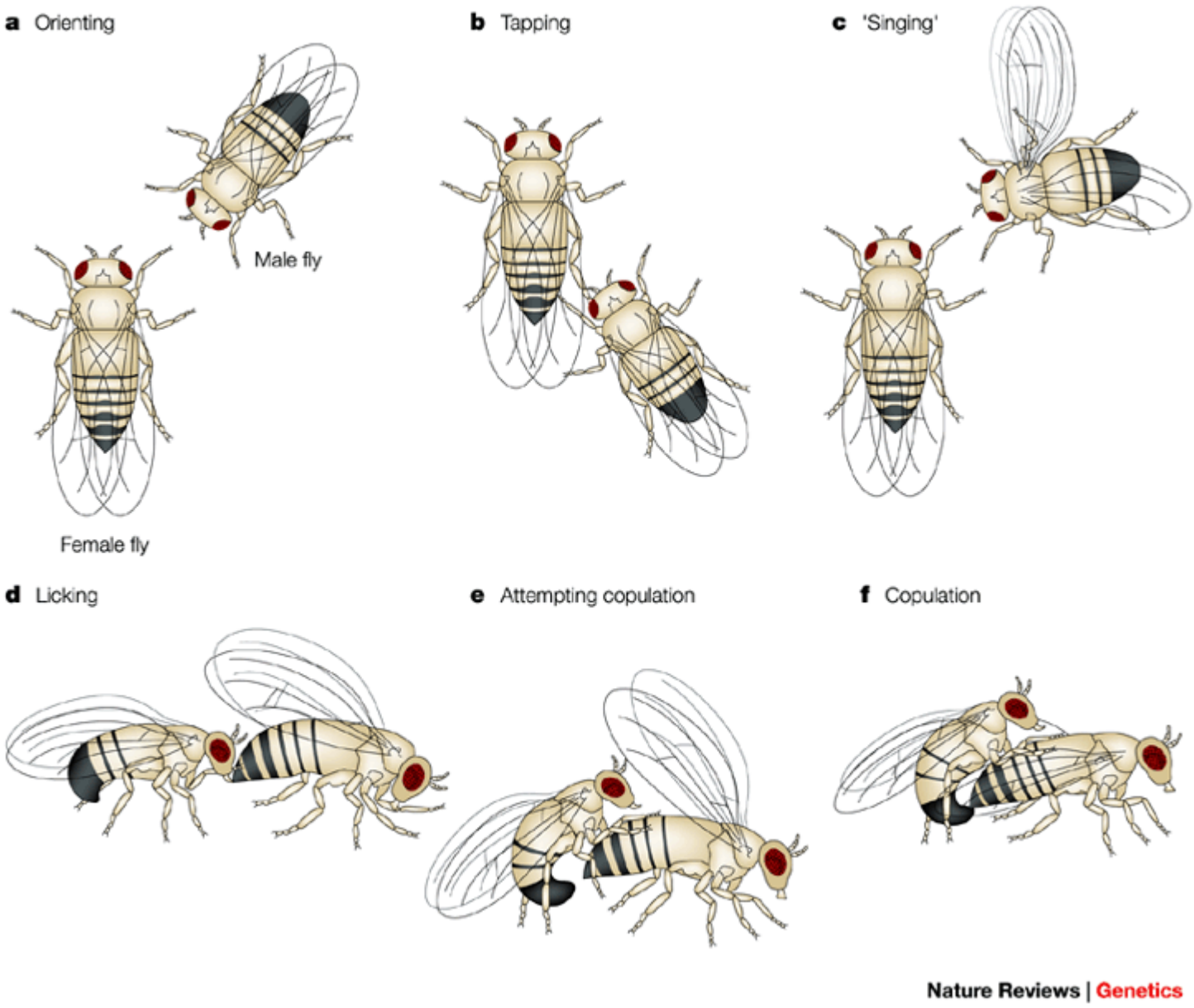


Image source: http://macro.art-scene.org/

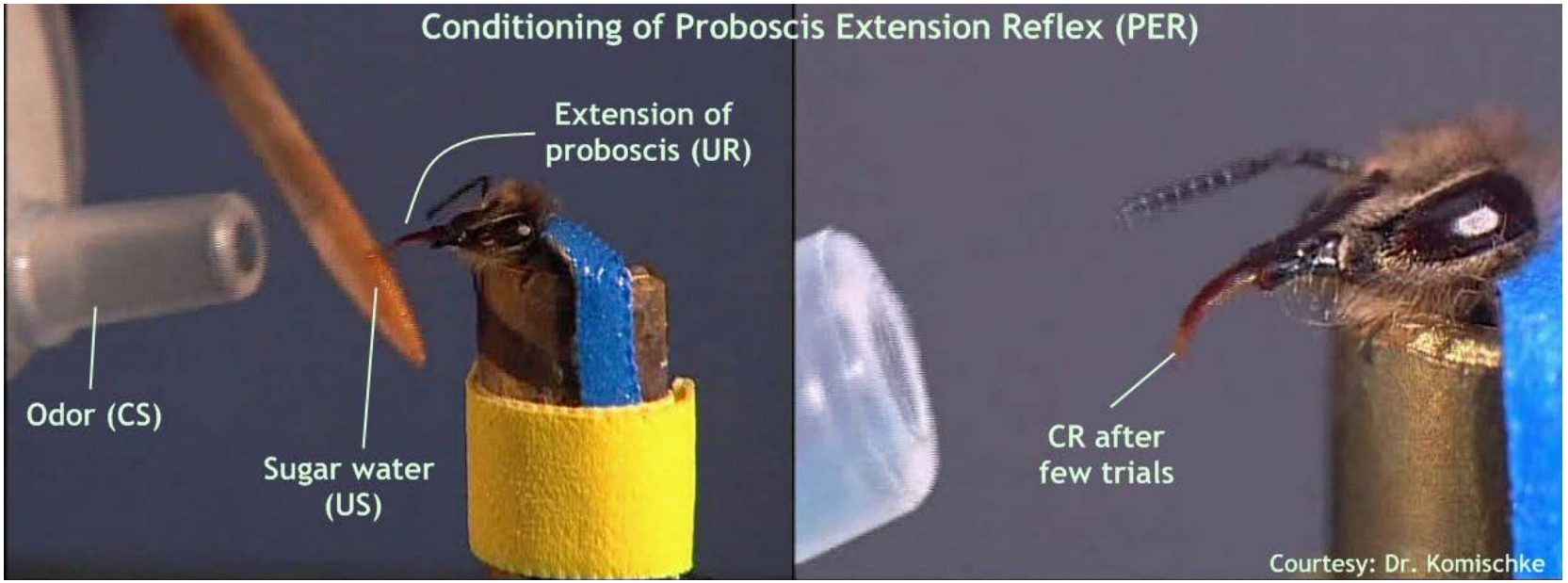
Drosophila Courtship



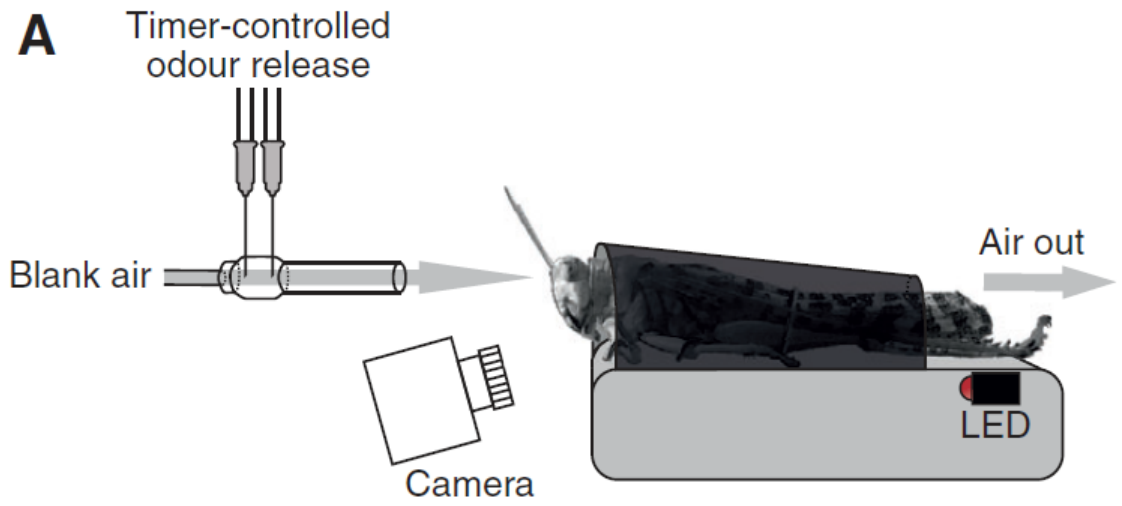
Do insects exhibit only fixed behaviors, like pre-programmed robots?

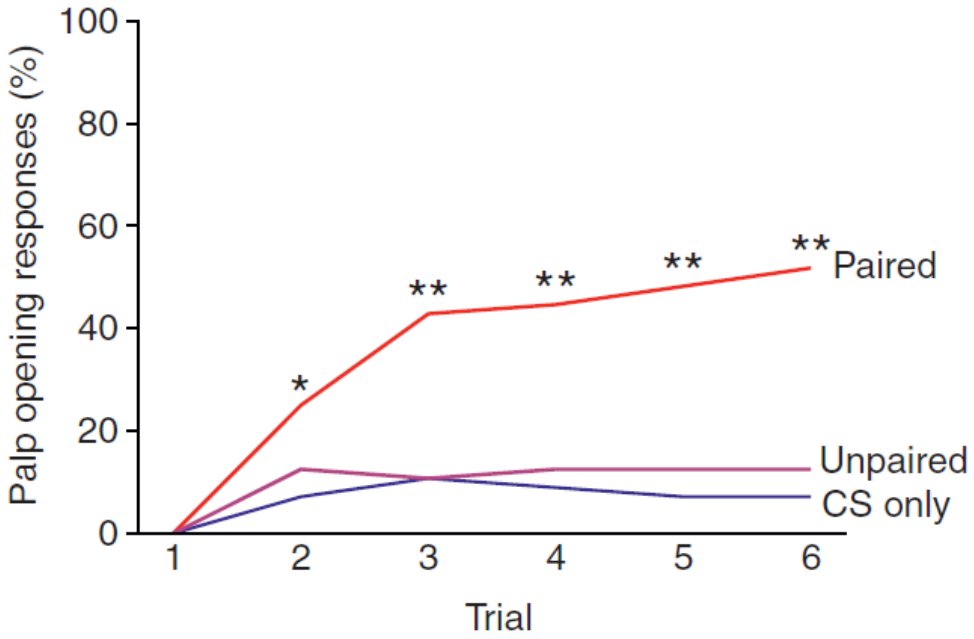
NO

Insects can learn: Proboscis Extension Reflex conditioning in honeybees



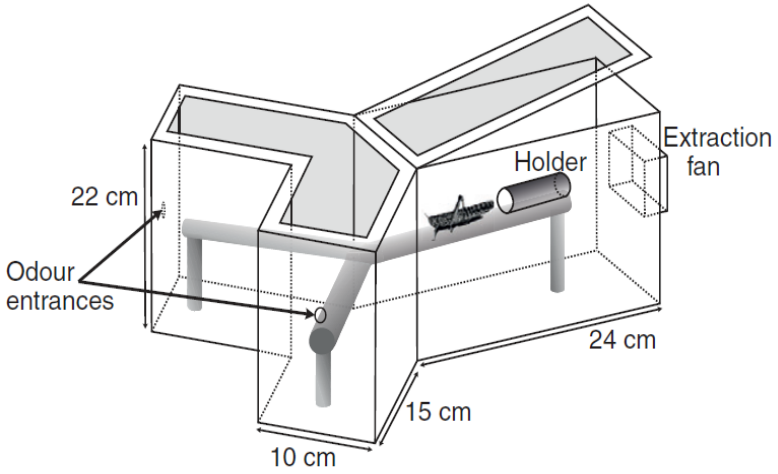
Olfactory learning in locusts

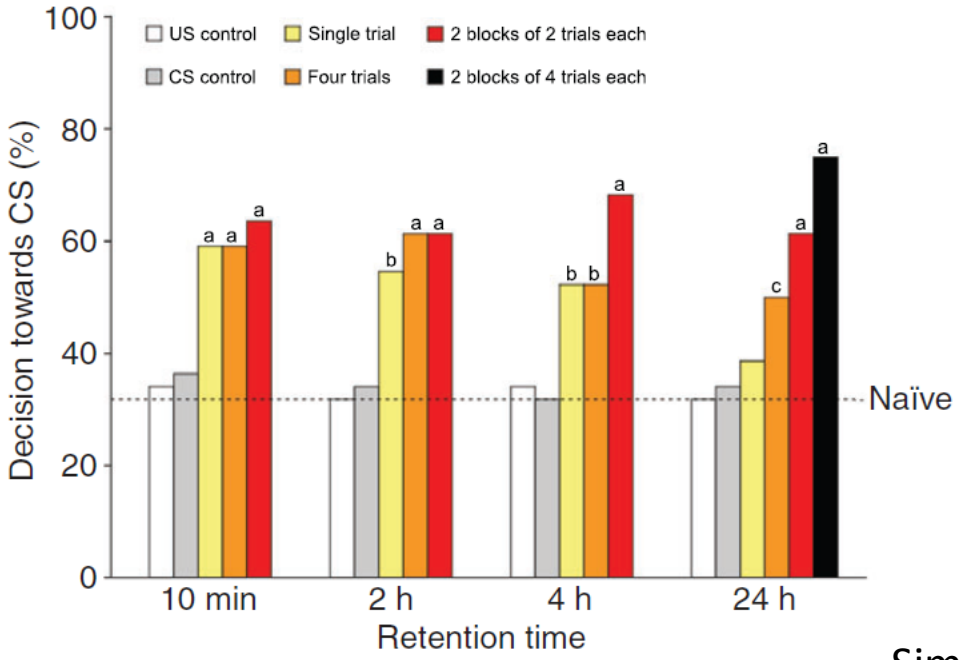




Simoes et al, *J Exp. Biol.* 2011

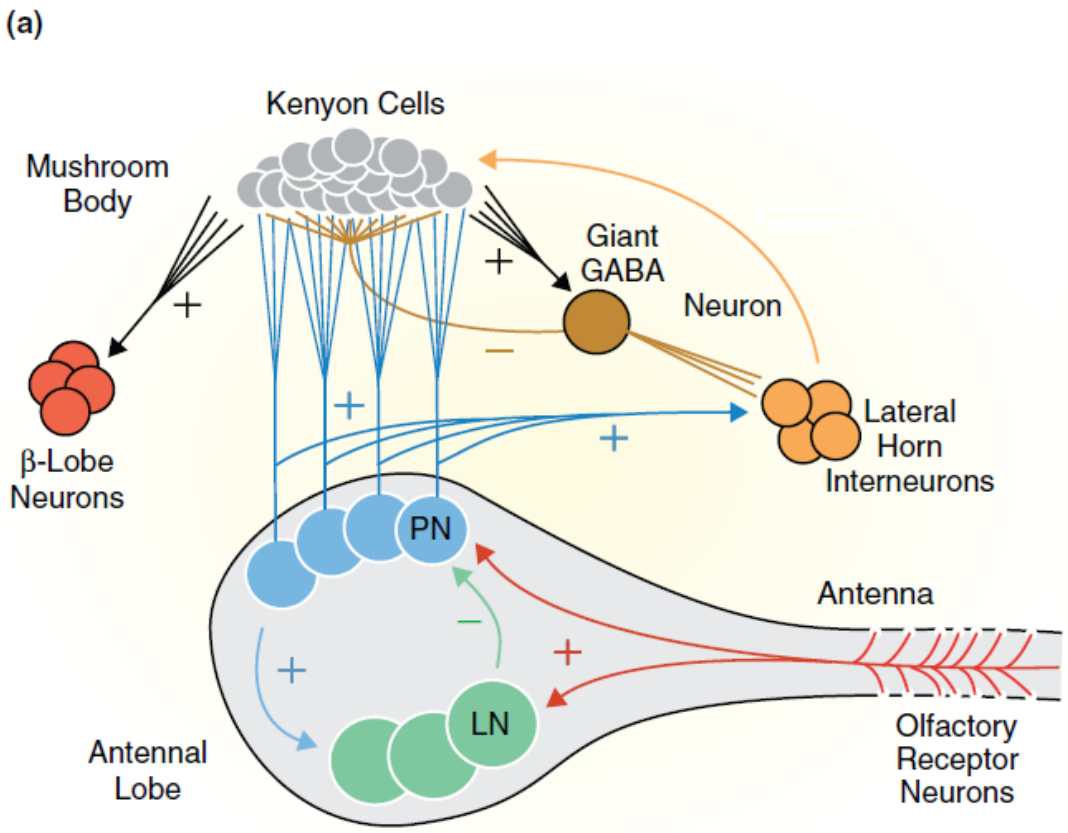
The new learning can be used in another context for making appropriate decisions

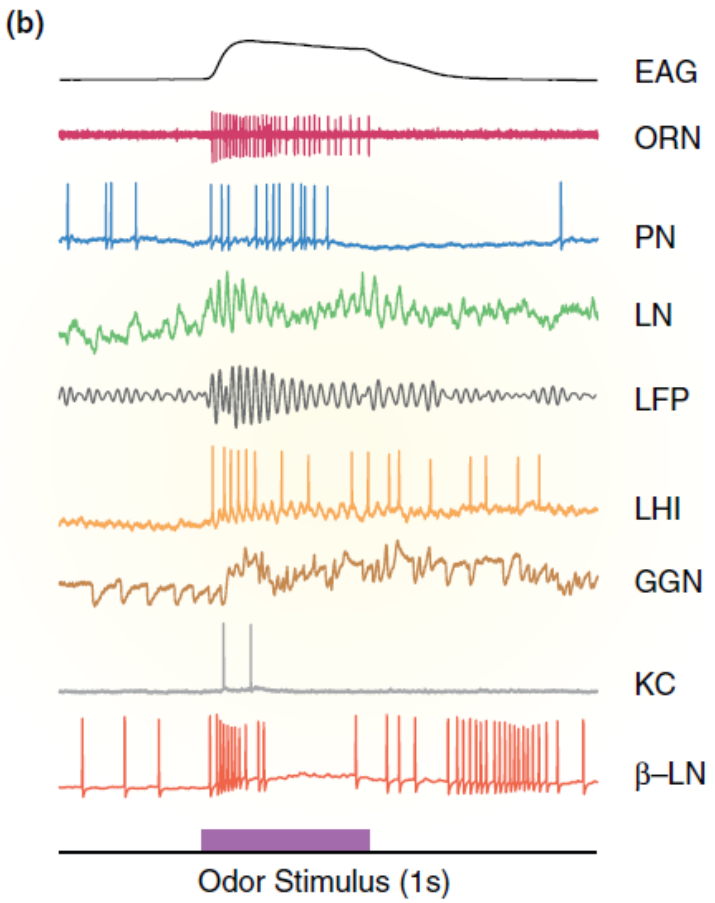




Simoes et al, *J Exp. Biol.* 2011

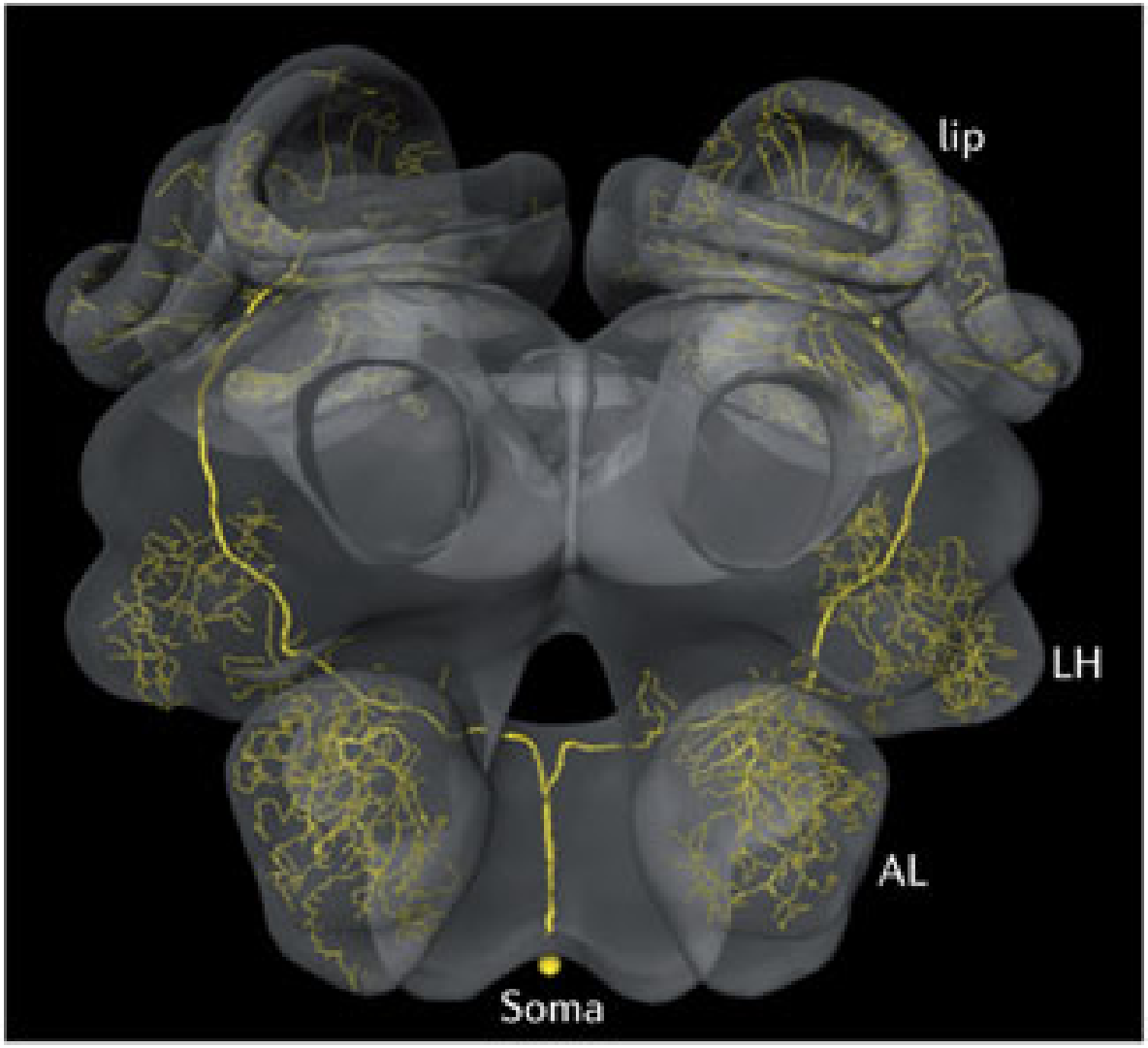
A brief overview of the locust olfactory system





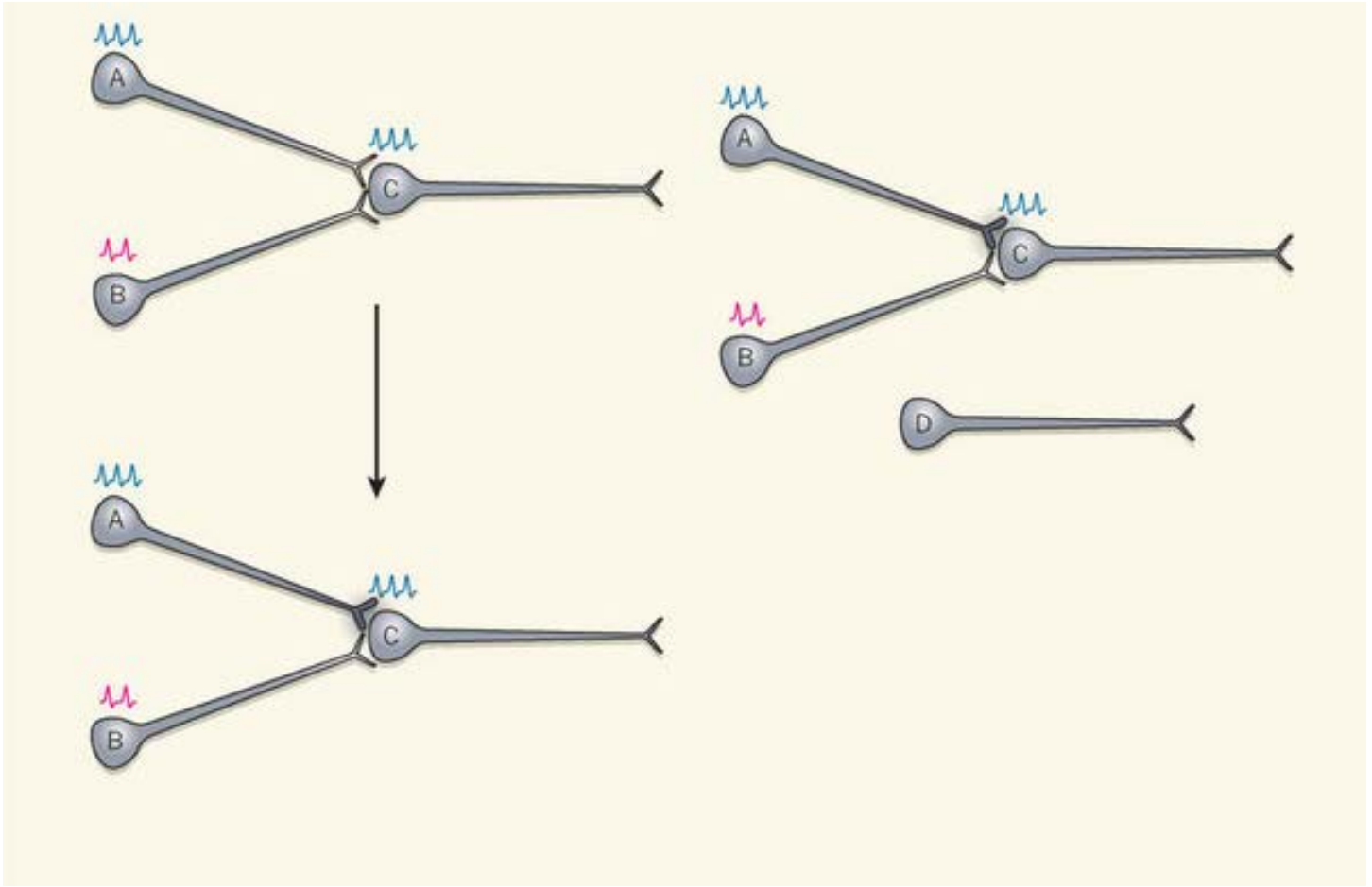
Gupta and Stopfer, *Current Opinion in Neurobiology* 2011

Reward signal is represented by another set of neurons



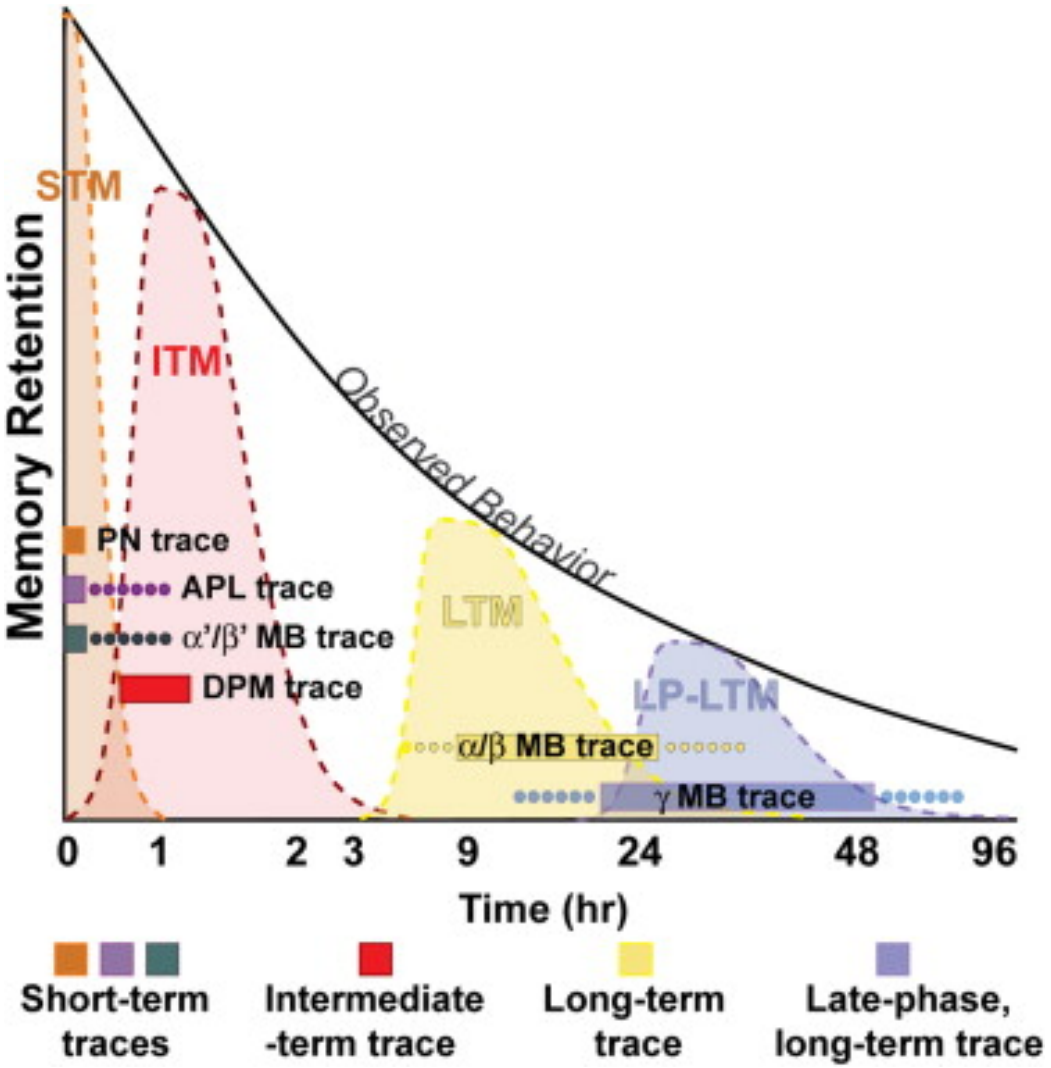
Nature Reviews | Neuroscience

A possible neural mechanism of associative learning: spike-timing dependent plasticity and its modulation by reinforcement signal



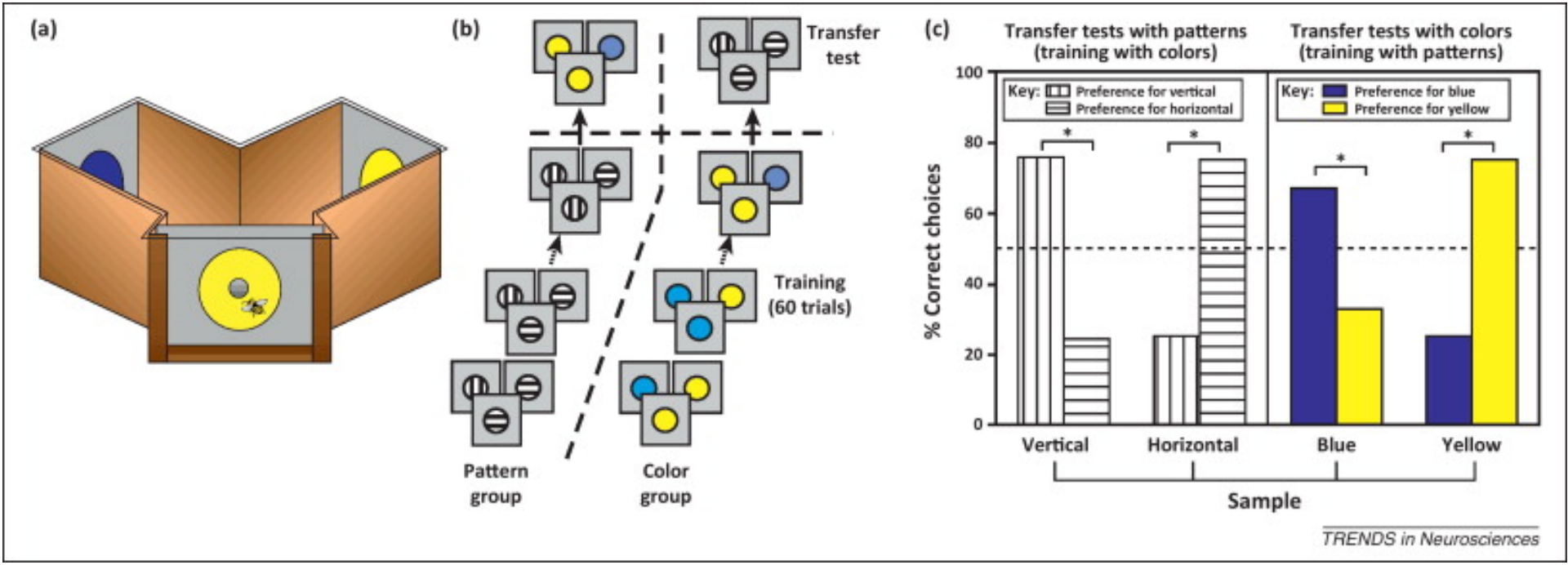
Cassenaer and Laurent, *Nature* 2012

Different flavors of memory may be based on different mechanisms



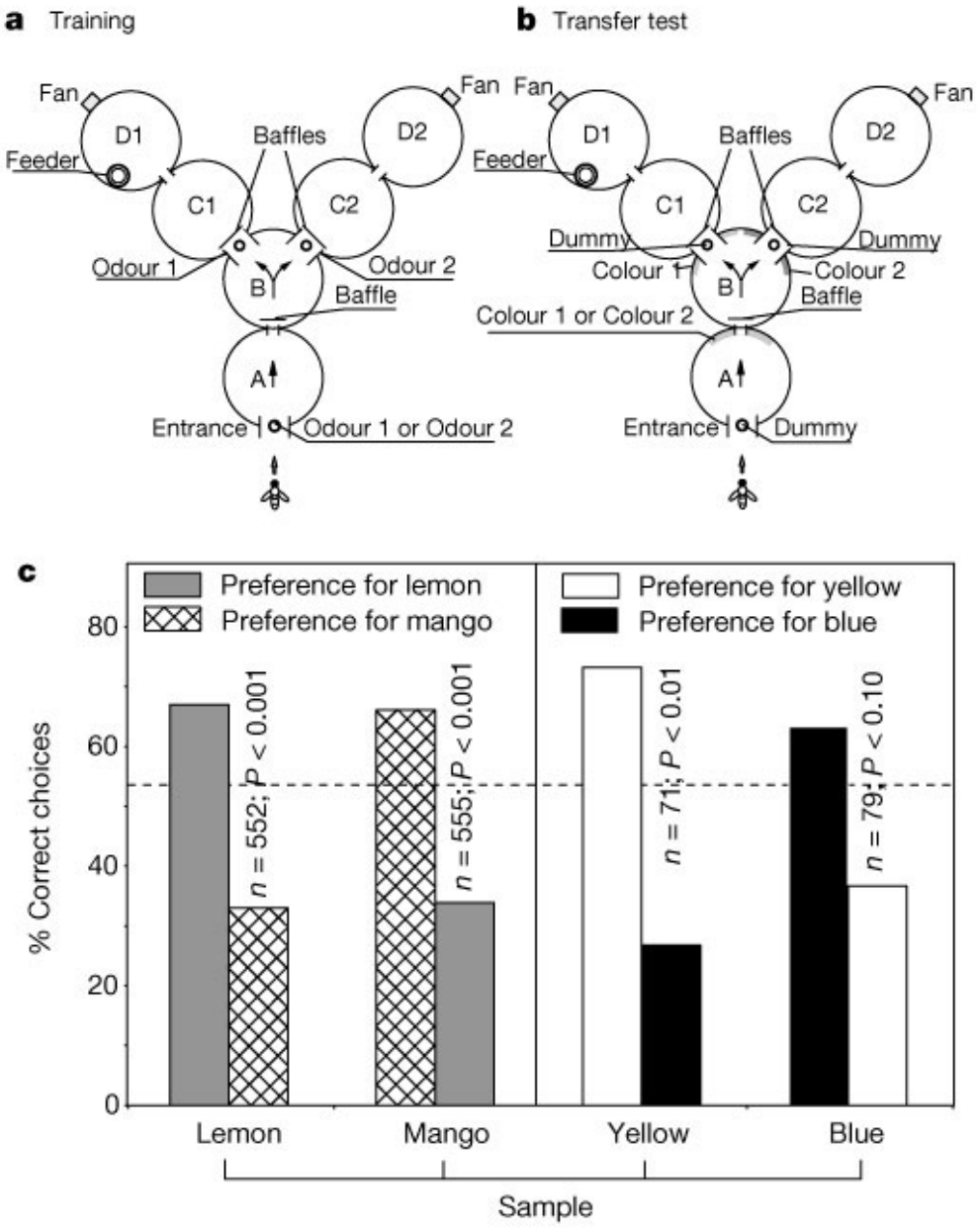
Davis, *Neuron* 2011

The concepts of “sameness” and “difference” in honeybees



Giurfa et al, *Nature* 2001

Concepts learnt from one sensory modality can be applied to another



Giurfa et al, *Nature* 2001

Insects provide very useful model systems for understanding the neural basis of basic cognitive abilities such as learning.