University of Zurich[UZH]

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Neural circuits

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BIO 344/376-1305

HS17

Map formation

What is a map?

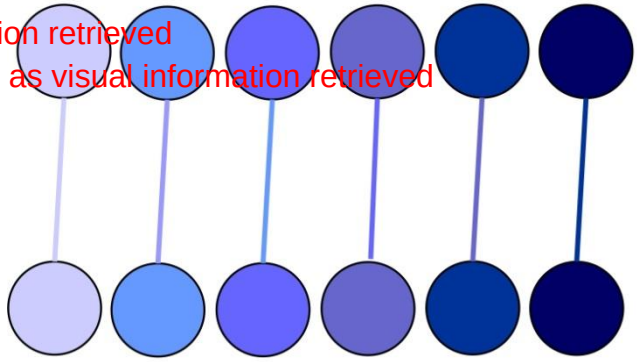
Are there different kinds of maps?

What is the fundamental difference between different types of maps?

The topographic map of the visual system preserves space information whereas the olfactory map preserves only quality of the stimulus but not location

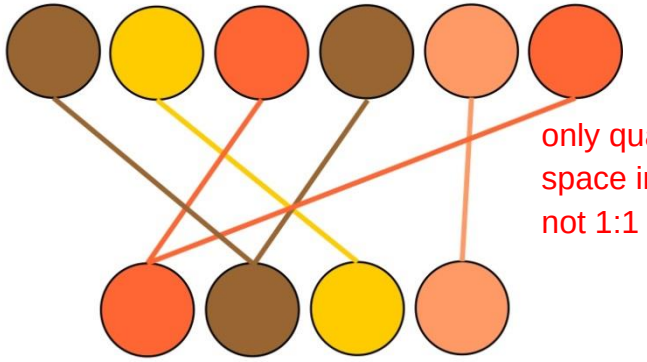
retina

space information retrieved
and 1:1 as well as visual information retrieved



tectum/superior colliculus

olfactory epithelium

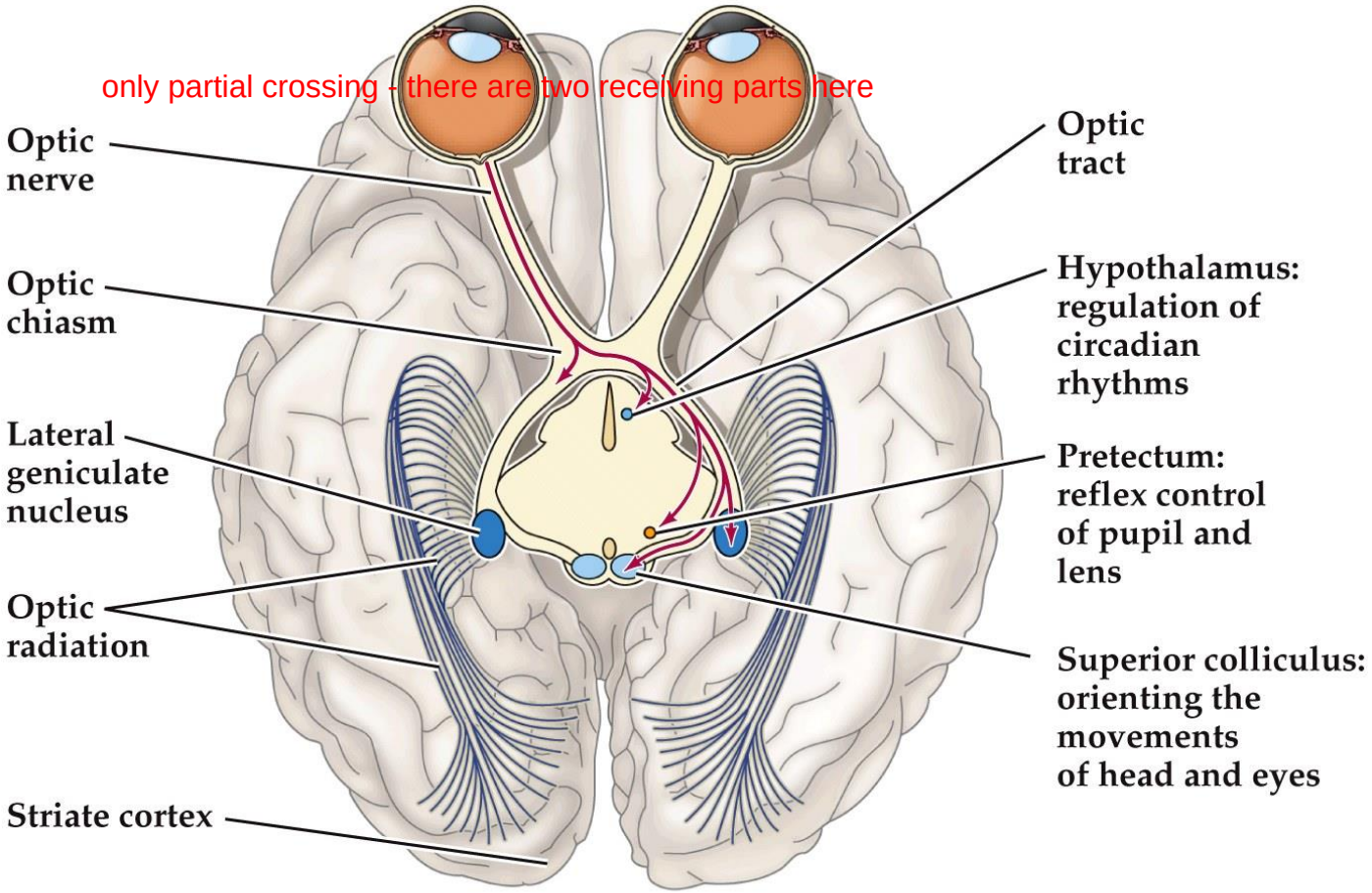


only quality of odor, no space information and not 1:1

olfactory bulb

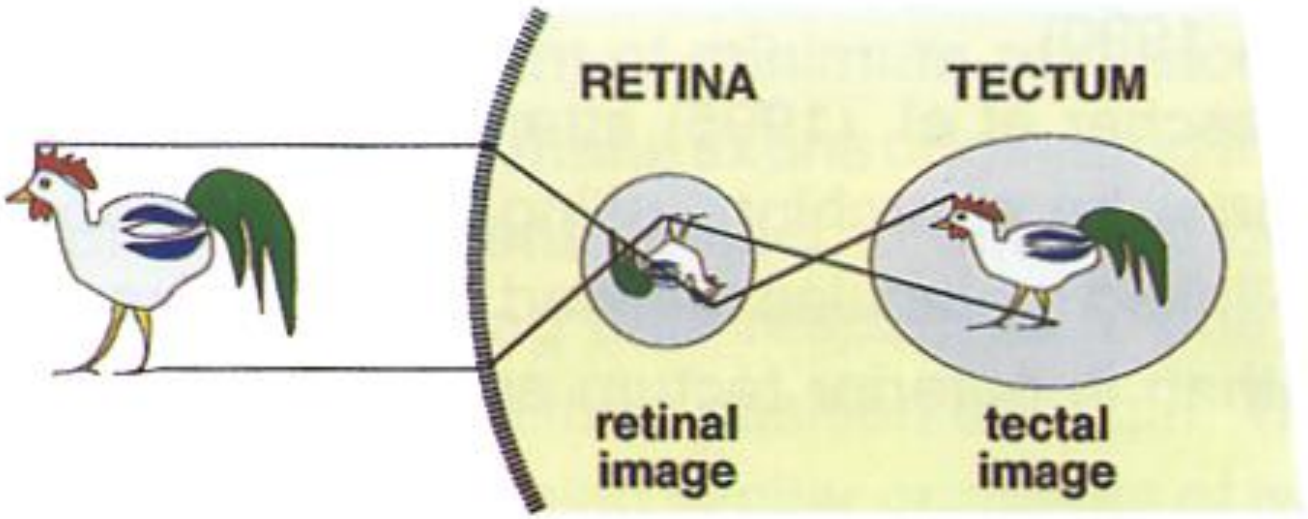
every neurons binds one odor - the activation gives the pattern which odor (molecules) it is.

In the visual system of mammals, projections from the retina are relayed in the lateral geniculate nucleus on their way to the visual cortex

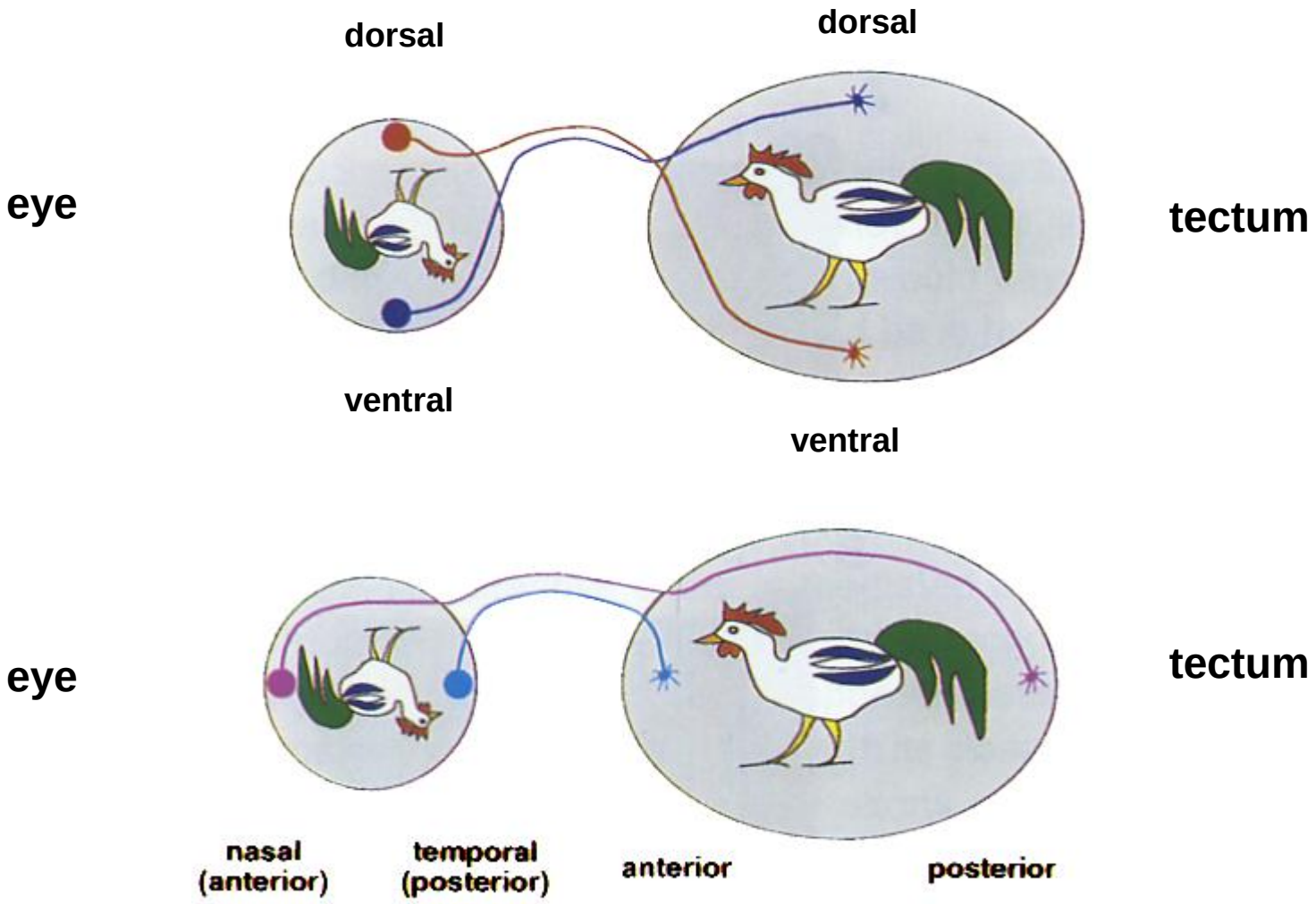


***NEUROSCIENCE 5e*, Figure 12.1**

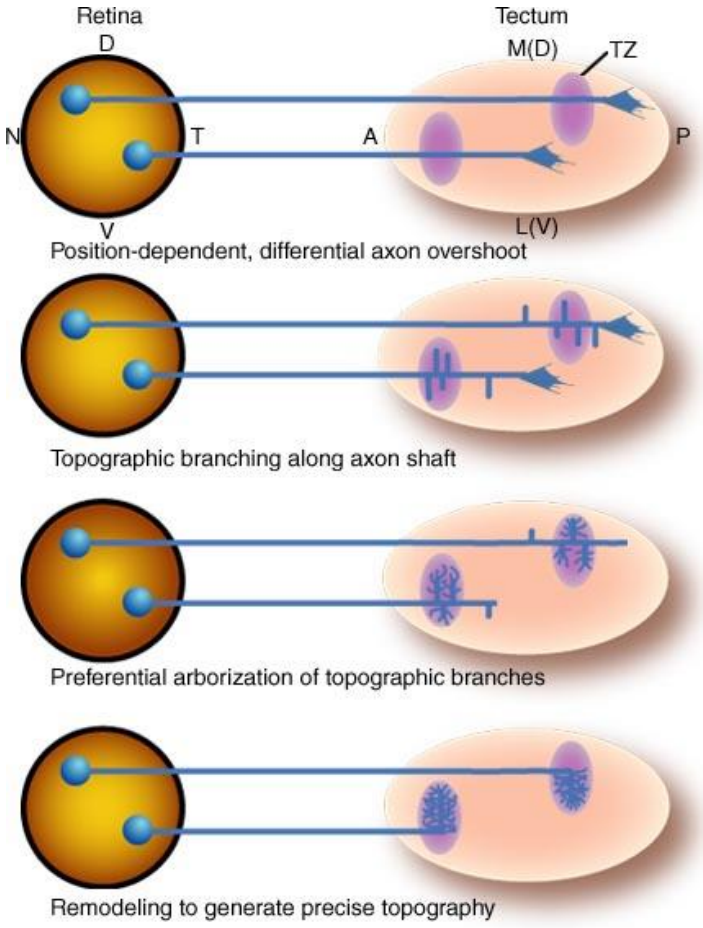
In the topographic map of the visual system the exact positional information of stimuli is preserved



Tessier-Lavigne, Cell 82(1995)345

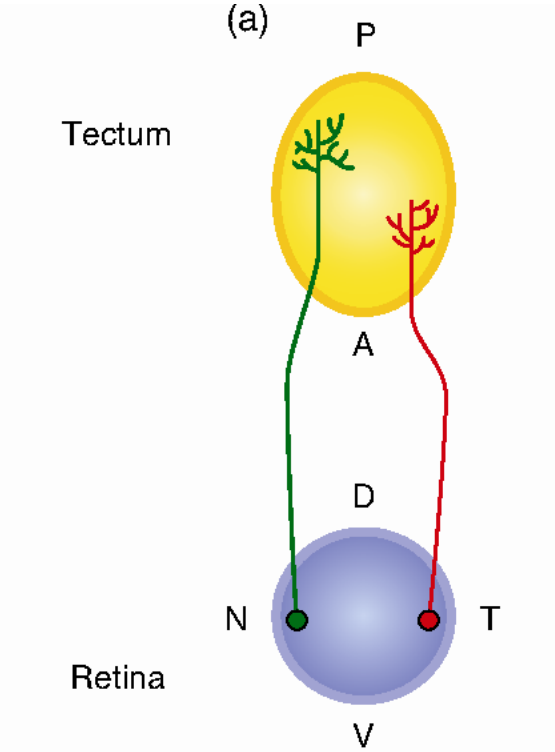

dorsal
dorsal
eye
tectum
ventral
ventral
eye
tectum
nasal
(anterior)
temporal
(posterior)
anterior
posterior

Use a simpler visual system to learn about neural circuit formation

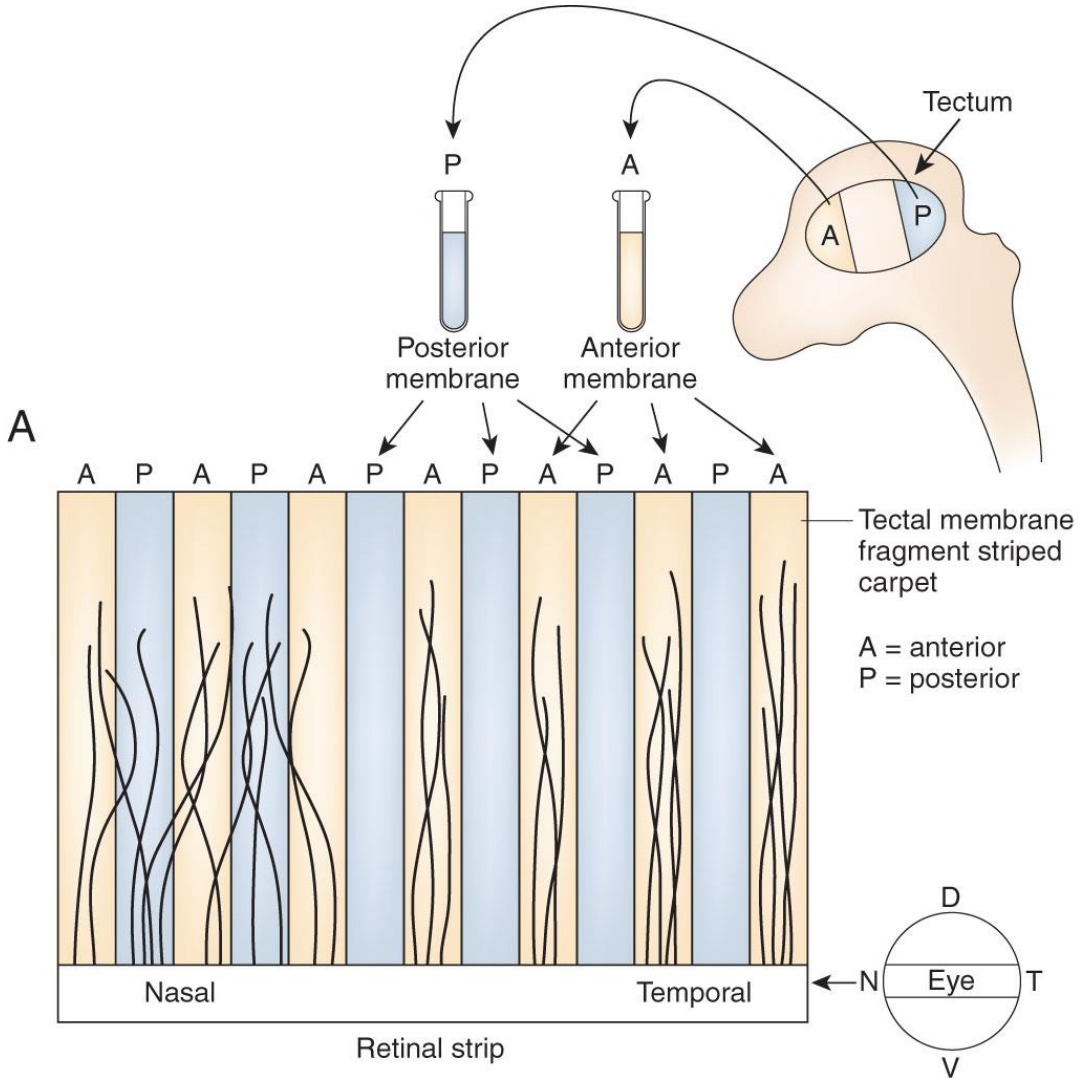


Forming a topographic map

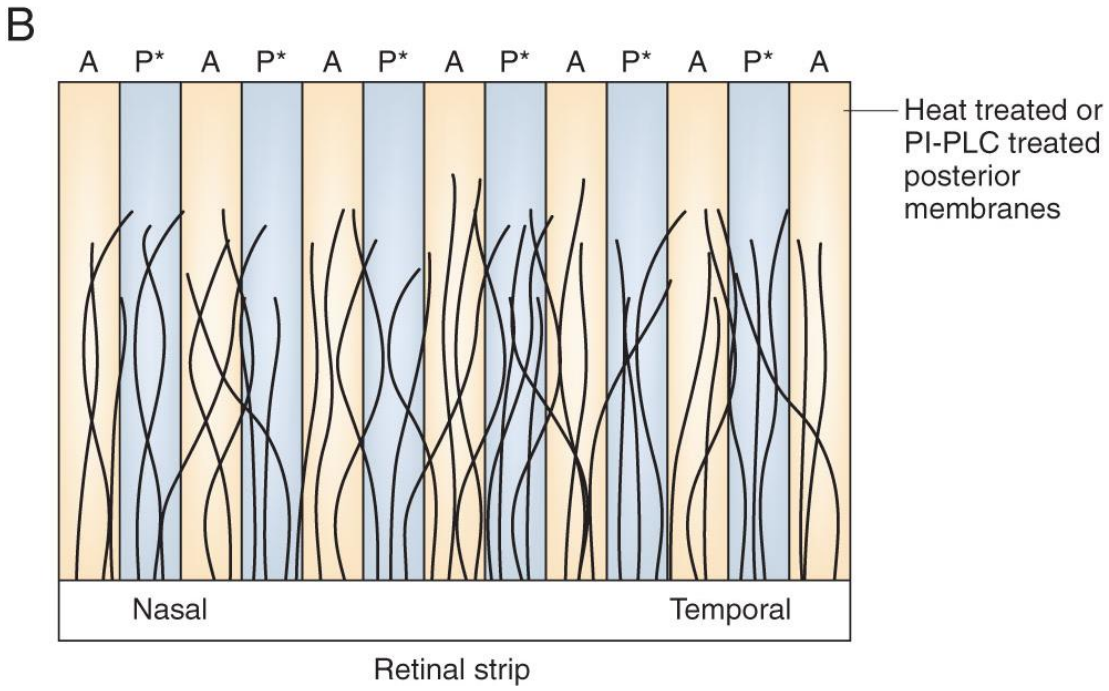
if you cut the tectum, it will be reinnovated and we have the same image anyway. one can also cut the retina in half and the entire system will recover anyway - not regenerate, but the topographical information will be regained.



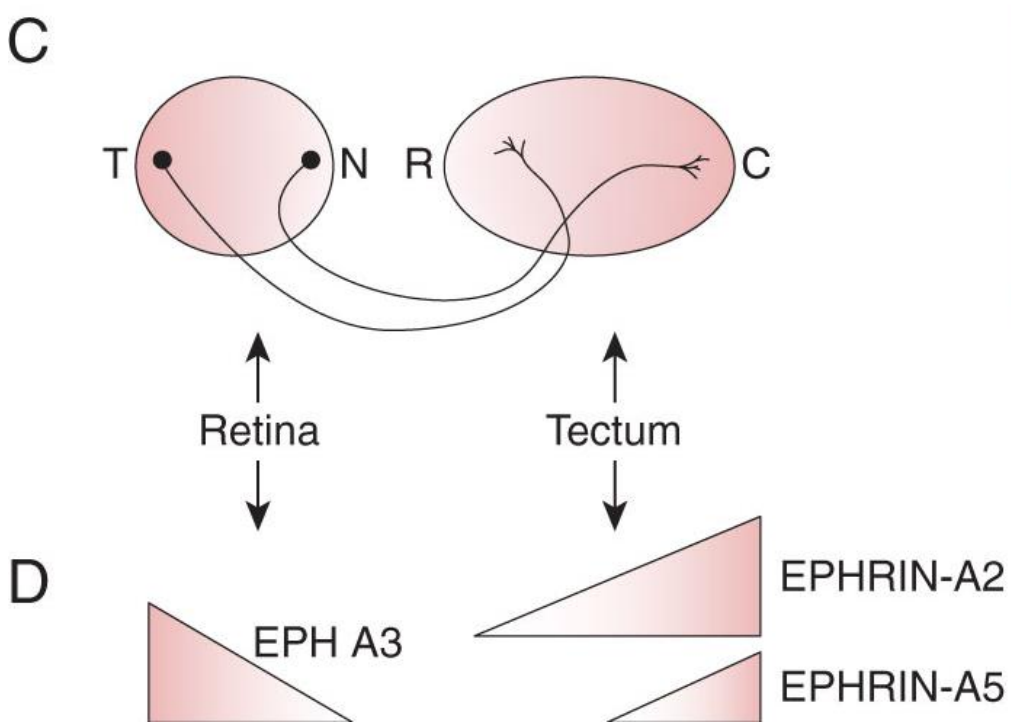
The Bonhoeffer stripe assay

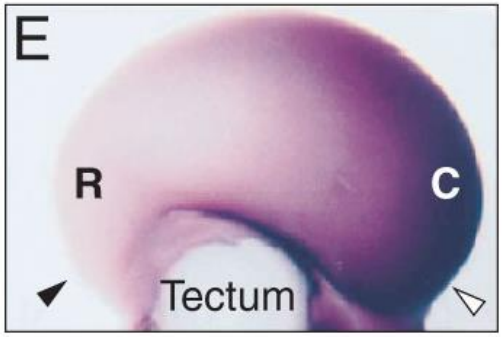


Axonal targeting in the tectum is determined by repulsive cues

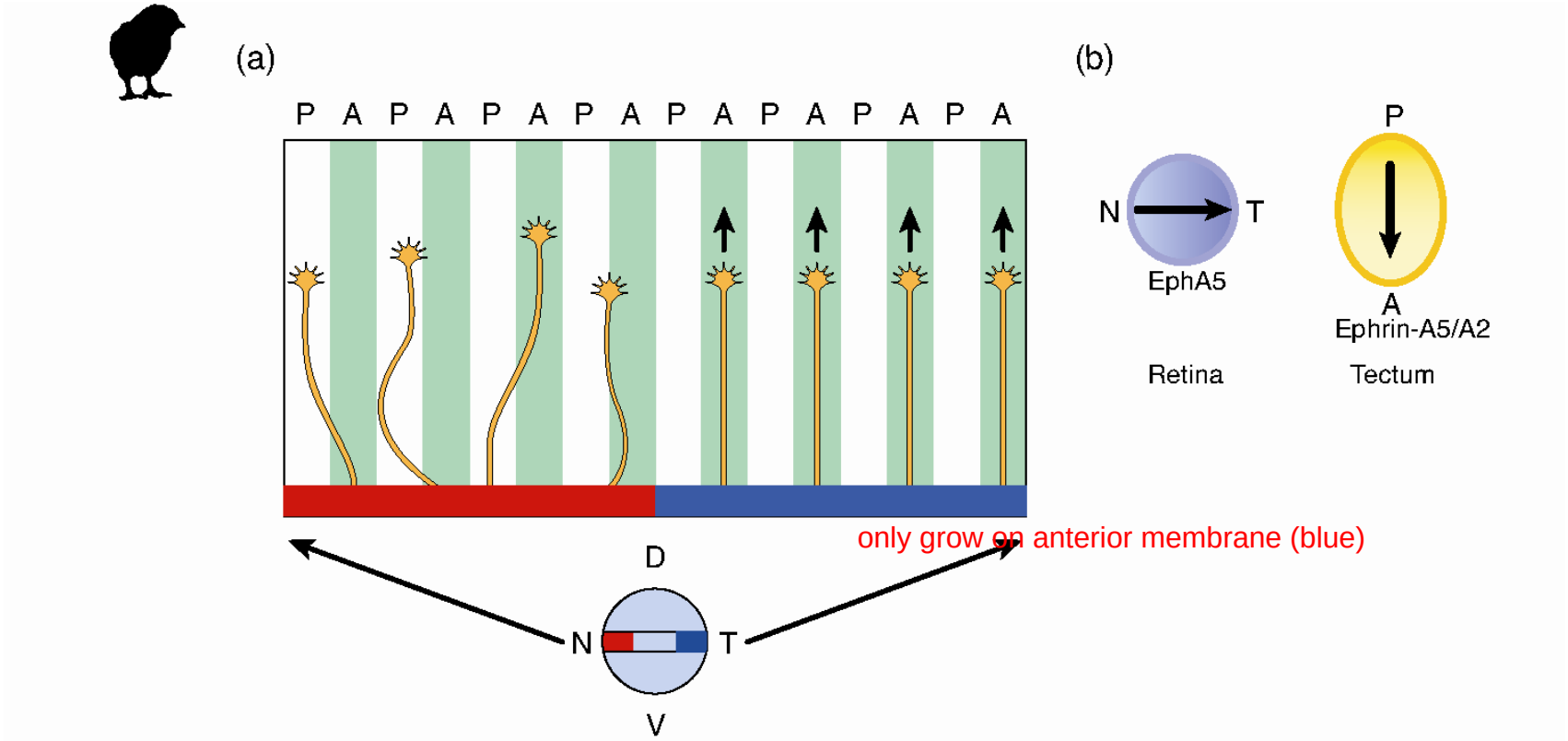


Gradients of Eph-receptors and Ephrins control retinal axon targeting

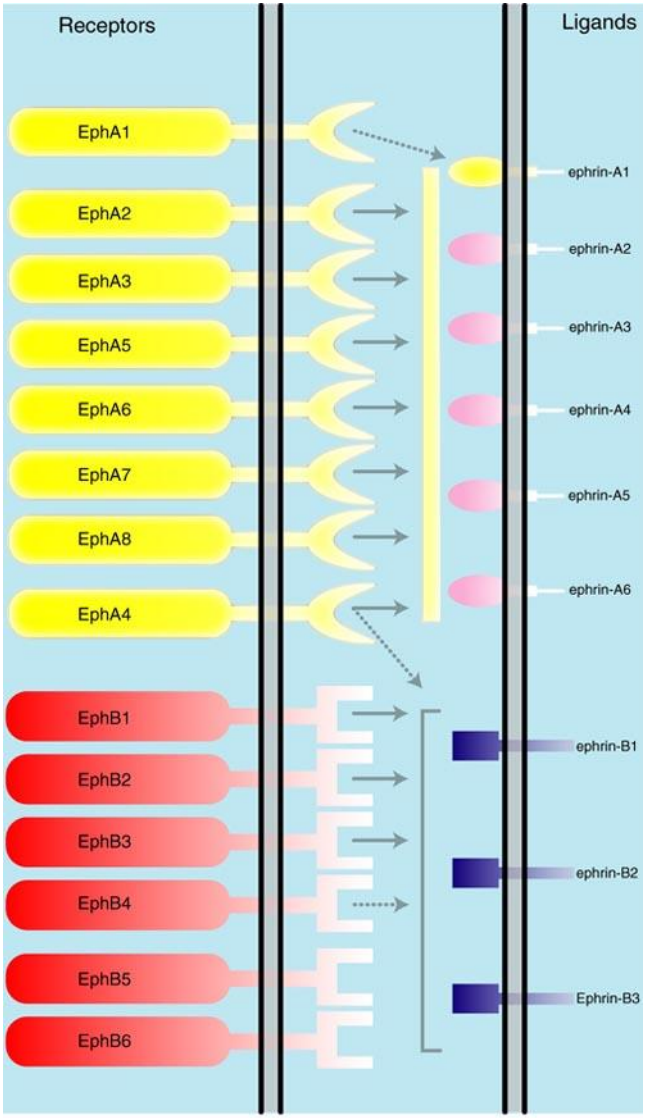




Temporal axons are repelled by high concentrations of Ephrins

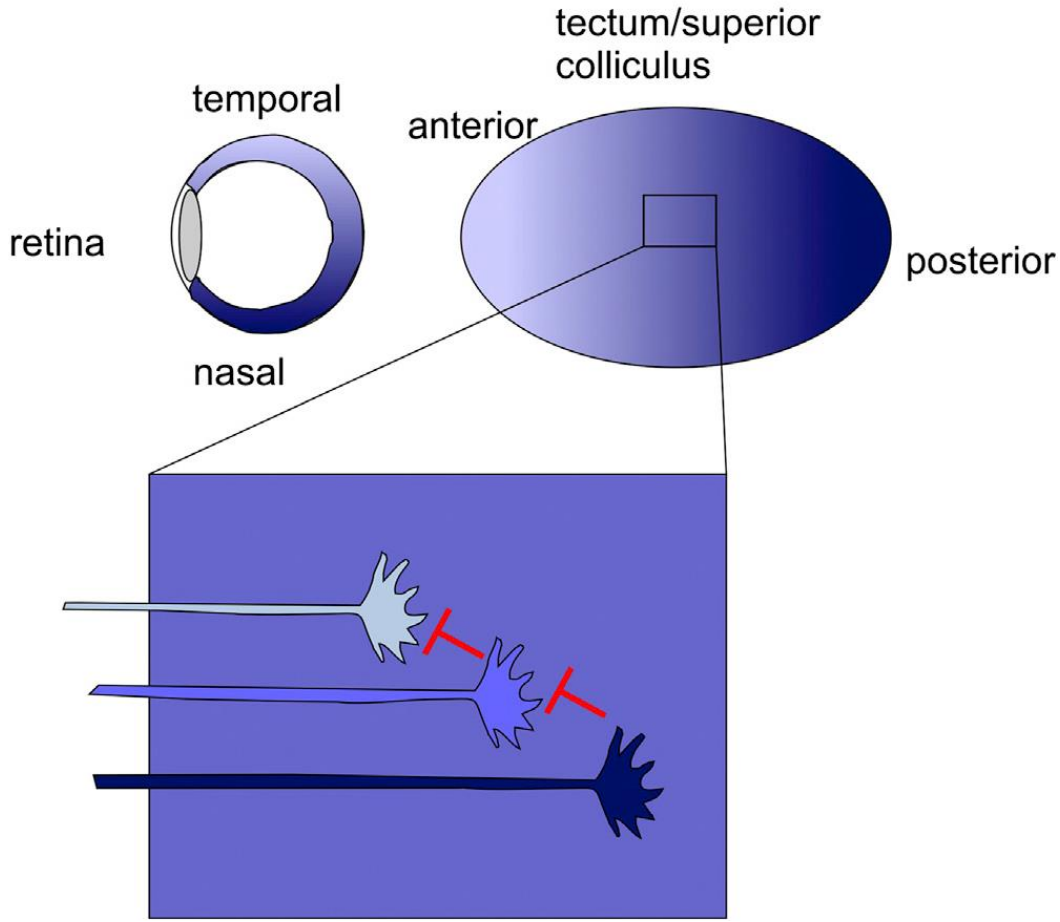


Eph receptors and Ephrins do not interact specifically



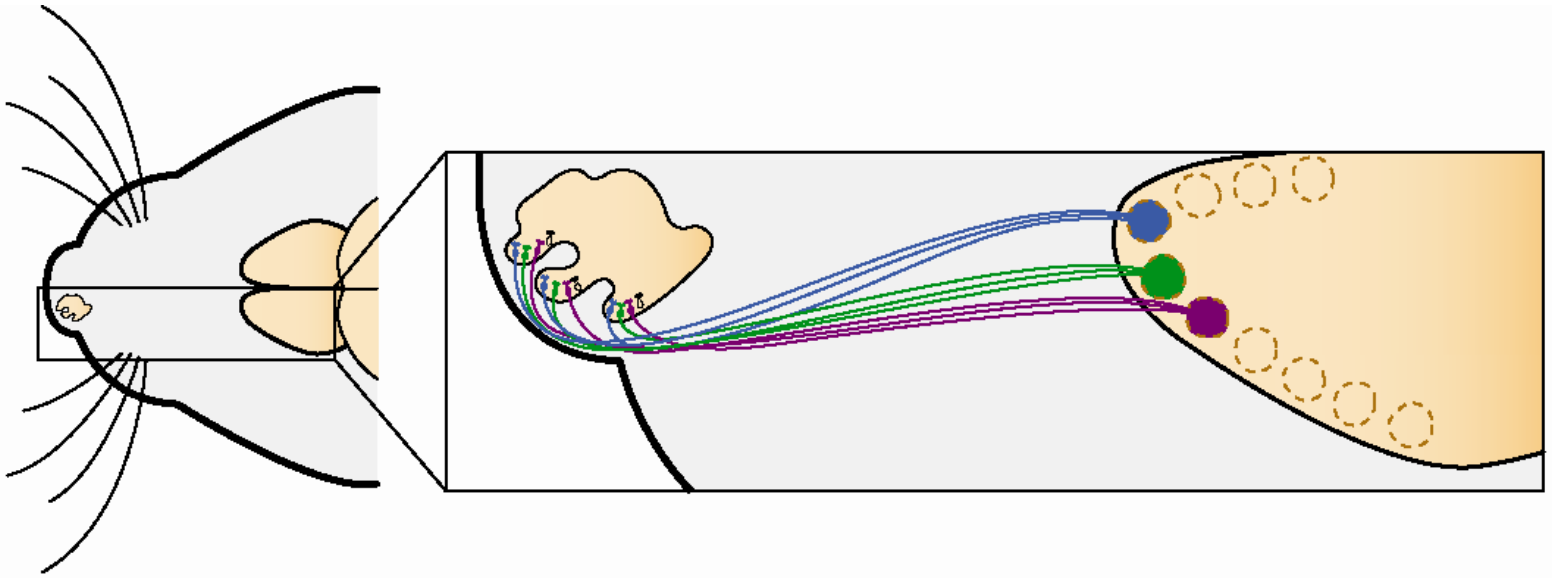
this was all true for the visual system. now follows the olfactory system (next slide)

Axon-axon competition contributes to topopgraphic map formation



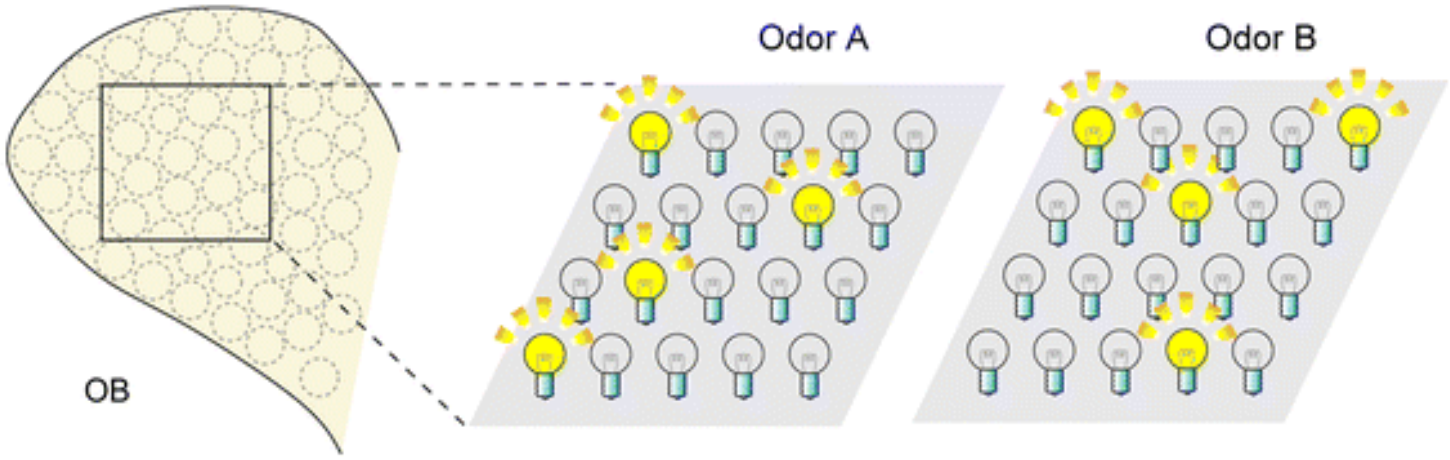
Stoeckli, Neuron 84(2014)655

Wiring the olfactory system

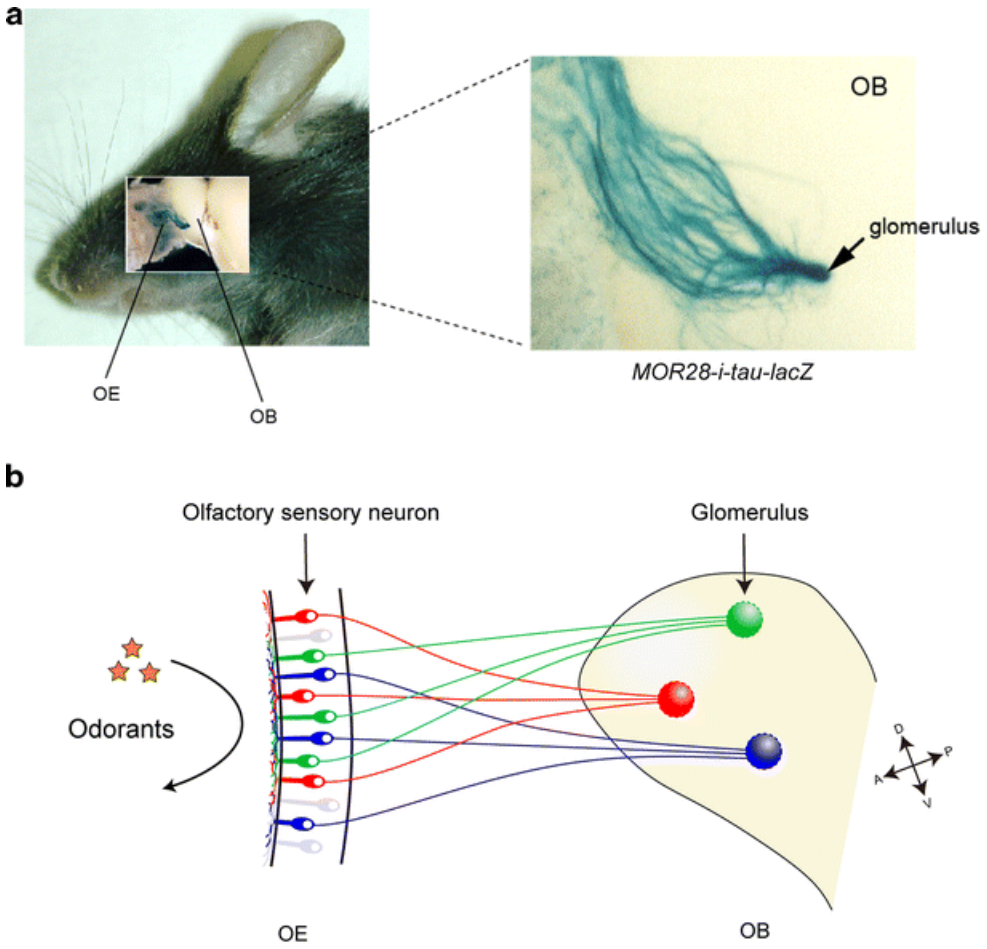


Building Brains, 2011

Spatial information is not included in the olfactory map



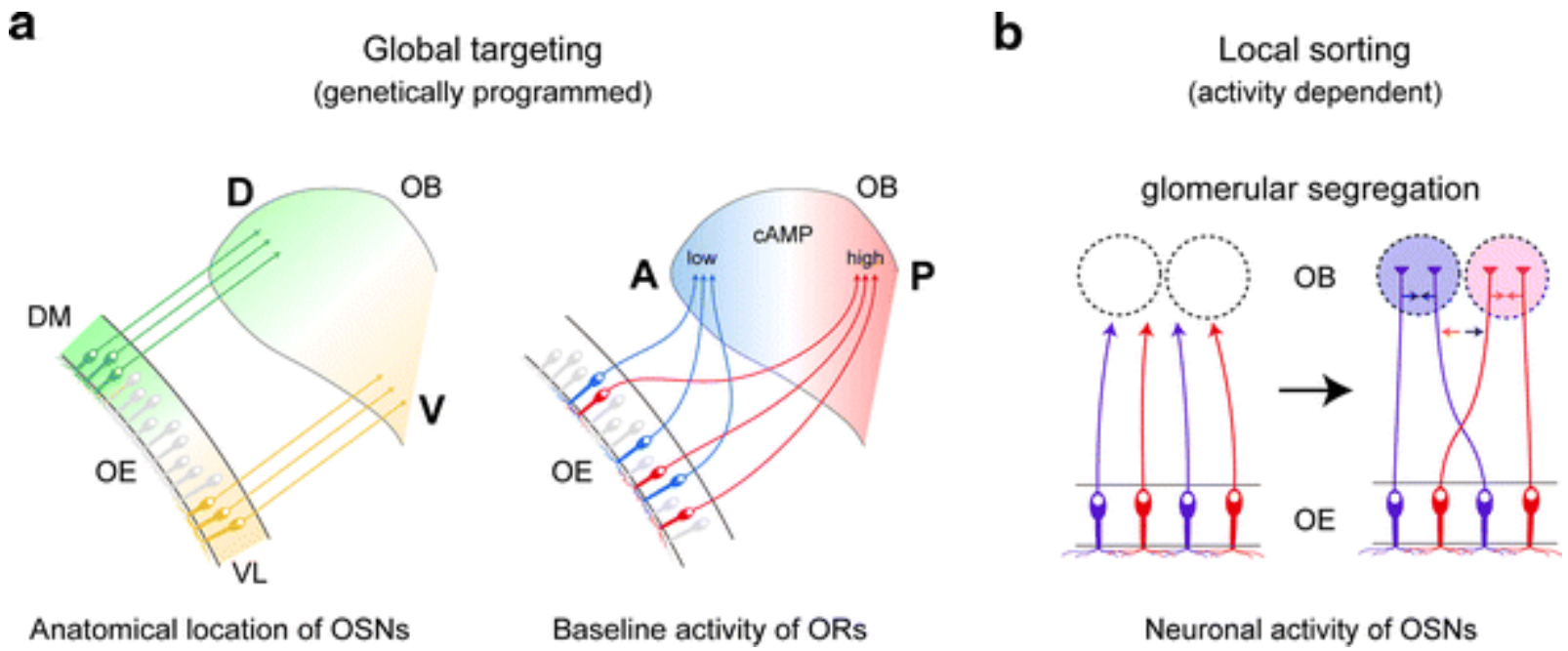
Axons from olfactory sensory neurons that respond to the same odor target the same glomerulus



One neuron – one receptor

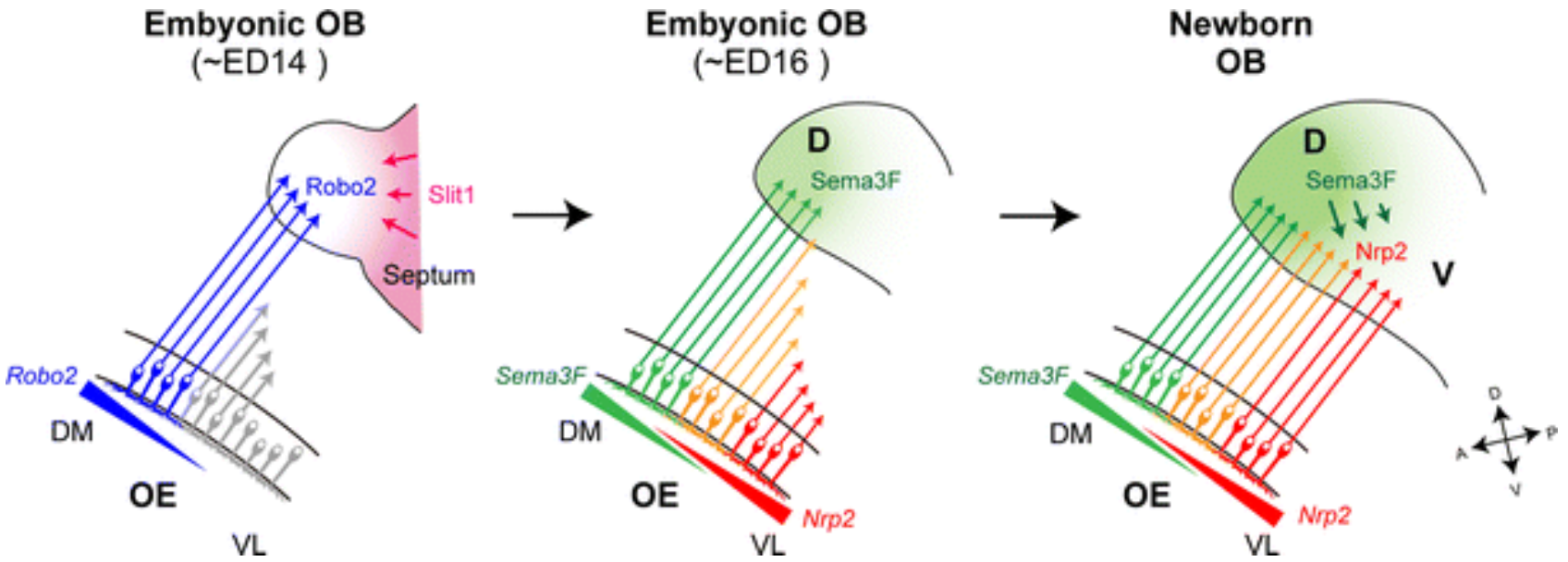
Takeuchi & Sakano, 2014

The olfactory map is established in a stepwise manner



Takeuchi & Sakano, 2014

Timing and expression of repellants is crucial for axonal targeting



Takeuchi & Sakano, 2014

Next week:

Dieter Zimmermann

Cell Migration