AXON GUIDANCE

Zic3 makes the gradient

During the development of the vertebrate eye, retinal ganglion cell axons converge on the optic disc, where they exit the eyeball to form the optic stalk. The mechanisms that guide these axons towards the optic disc are poorly understood — it was proposed that the disc itself might produce a long-range chemoattractant, but no such activity has been identified in this region. Now, Zhang and colleagues present evidence that graded expression of the transcription factor Zic3 induces the generation of a repulsive force, which channels retinal axons towards the optic disc.

Using *in situ* hybridization, the authors showed that the *Zic3* gene is normally expressed in a gradient within the retina, with the highest concentration at the periphery and the lowest at the centre. They disrupted this gradient by transfecting the embryonic chick retina with a Zic3-expressing retroviral vector. This caused various axon guidance defects, including stalling of growth cones within the sites of transfection, and, less frequently, axons turning 180° to project back towards the periphery of the retina.

Next, Zhang *et al.* presented retinal ganglion cells in culture with the choice of growing on retinal membrane fragments that were transfected with either a control green fluorescent protein-expressing retroviral construct or the Zic3-expressing construct. When they were faced with alternating stripes of these two tissues, the cells extended axons preferentially on the control stripes. Similarly, when the cells were presented with alternating stripes of membrane from the centre and the periphery of the retina, most of their axons grew along the stripes from the centre of the retina.

Taken together, these findings indicate that Zic3-expressing tissue releases a factor that repels the axons of retinal ganglion cells. Zic3 is not the first Zic family member to be implicated in axon guidance in the visual system — Zic2 was recently shown to be involved in controlling axon crossing at the optic chiasm. As the Zic proteins are transcription factors, they presumably act by inducing the expression of guidance cues. So, to understand their roles in axon guidance, it will be important to identify their downstream targets.

Heather Wood

References and links

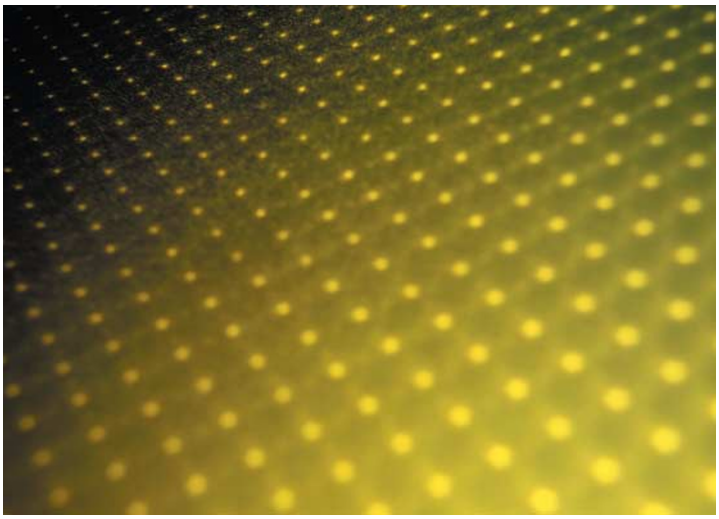
ORIGINAL RESEARCH PAPER Zhang, J. *et al.* Disruption of gradient expression of Zic3 resulted in abnormal intraretinal axon projection. *Development* **131**, 1553–1562 (2004)

FURTHER READING Herrera, E. *et al.* Zic2 patterns binocular vision by specifying the uncrossed retinal projection. *Cell* **114**, 545–557 (2003)

WEB SITES

Bao laboratory: http://www.umassmed.edu/cellbio/faculty/bao.cfm

Encyclopedia of Life Sciences: http://www.els.net/ visual system development in vertebrates



IN BRIEF

SYNAPTIC PHYSIOLOGY

Roles of glutamate transporters in shaping excitatory synaptic currents in cerebellar Purkinje cells.

Takayasu, Y. *et al. Eur. J. Neurosci.* **19**, 1285–1295 (2004)

The authors used a blocker of glutamate transporters, DL-*threo*-β-benzyloxyaspartate (DL-TBOA) to investigate the role of these transporters in cerebellar synapses. Blocking glutamate transporters prolonged excitatory postsynaptic potentials in cerebellar Purkinje cells. DL-TBOA seems to increase the time for which synaptically released glutamate is present and also induces glutamate spillover to neighbouring targets. The results indicate that glutamate transporters are an important influence on synaptic transmission at these synapses.

NEURAL DEVELOPMENT

Columnar architecture sculpted by GABA circuits in developing cat visual cortex.

Hensch, T. K. & Stryker, M. P. *Science* **303**, 1678–1681 (2004)

Specific $GABA_A$ circuits for visual cortical plasticity.

Fagiolini, M. *et al. Science* **303**, 1681–1683 (2004)

Two papers from Hensch and colleagues give important new insights into the development of ocular dominance columns in the visual cortex. In the first, Hensch and Stryker used benzodiazepines to modulate the inhibitory activity in the visual cortex of kittens. Diazepam, which potentiates inhibitory activity, caused the columns to become broader, whereas treatment with DMCM, which reduces inhibition, made the columns narrower. To investigate further how inhibitory inputs shape the development of cortical segregation in the visual system, Fagiolini *et al.* used a mouse knock-in mutation to make specific types of $GABA_A$ (γ-aminobutyric acid, subtype A) receptor insensitive to diazepam. They found that receptors containing the α1 subunit were needed for diazepam to be able to influence ocular dominance plasticity, indicating that this subtype of receptor is responsible for shaping ocular dominance columns in the developing visual cortex.

COGNITIVE NEUROSCIENCE

Your own action influences how you perceive another person's action.

Hamilton, A. *et al. Curr. Biol.* **14**, 493–498 (2004)

The authors tested the hypothesis that the motor system is responsible for decoding the observed action of others by asking subjects to judge the weight of a box being lifted by another person while they lifted or held a light or heavy box. Actively lifting a heavy box led to a perception of the observed box as being lighter, whereas lifting a light box meant that the observed box was judged to be heavier. The authors propose a model that can account for these results by using overlapping neural systems for motor control and action understanding to process multiple models of observed and performed actions.