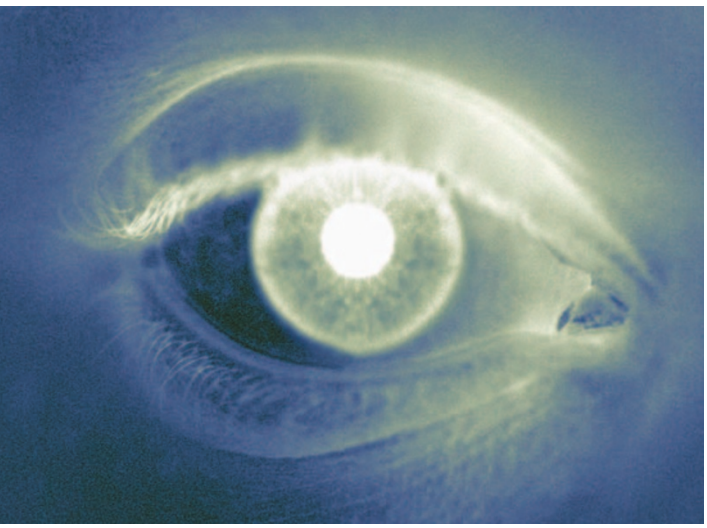
DEVELOPMENT

Eye catching

For visual information to be accurately relayed from the eye to the brain precise topographic connections between retinal cells and visual centre neurons are essential. New work by Tabata and colleagues reveals that, during development of the *Drosophila* visual system, Hedgehog (HH) signalling from growing retinal axons (R axons) to neurons of the lamina optic ganglion is required for the two to catch hold and establish connections. The group also identify the transcription factor, Single-minded (SIM), as a lamina neuron target of HH, and show that this, too, is required for R axon–lamina connections.



The *Drosophila* compound eye is composed of 750 visual units, each of which contains eight photoreceptor (retinal) cells. During development of the visual system, the first six of these (R1–6) extend axons (R axons) to the lamina optical ganglion. Immature precursor neurons, residing in the pre-assembling region of the lamina, receive HH signals from arriving R axons and are induced to differentiate. Subsequent associations between these differentiating neurons and R axons form preliminary structures called lamina columns. These arise in the assembling region and later consolidate synaptic partnerships into final lamina cartridges.

To investigate the precise role of HH in the formation of lamina columns and cartridges, Tabata *et al.* generated flies containing both wild type and $smo^{-/-}$ lamina neurons — Smoothened (SMO) being an essential component of the HH receptor. They found that $smo^{-/-}$ lamina neurons, unlike their wild type counterparts, were never observed in the assembling region (supporting a similar finding by Huang and Kunes) but were, instead, restricted to the pre-assembling region, suggesting that $smo^{-/-}$ cells were defective in their ability to interact with R axons and form lamina columns.

As the expression of SIM protein is restricted to lamina neurons and is abolished in cells that lack SMO, the group asked whether SIM might also be involved in lamina–R axon connections. They found that, like $smo^{-/-}$ neurons, $sim^{-/-}$ neurons were restricted to the pre-assembling region. In addition, ablating SIM function in lamina neurons by overexpressing a dominant-negative mutant of dARNT protein (a transcription factor partner of SIM) also prevented these cells from entering the assembling region to form lamina columns. Therefore, knocking out SIM reproduced the phenotype of knocking out HH signalling.

Although it is yet to be determined whether SIM overexpression can recover the $smo^{-/-}$ phenotype, it seems likely that the two factors act in the same pathway. And, as both HH and SIM have conserved mammalian homologues, such studies into the fly's visual system might well provide insight into the pathways responsible for topographic network formation in mammals.

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ORIGINAL RESEARCH PAPER Umetsu, D. *et al.* The highly ordered assembly of retinal axons and their synaptic partners is regulated by Hedgehog/Single-minded in the *Drosophila* visual system. *Development* 26 Jan 2006 (doi:10.1242/dev.02253)
FURTHER READING Huang, Z. & Kunes, S. Signals transmitted along retinal axons in Drosophila: Hedgehog signal reception and the cell circuitry of lamina cartridge assembly. *Development* **125**, 3753–3764 (1998)