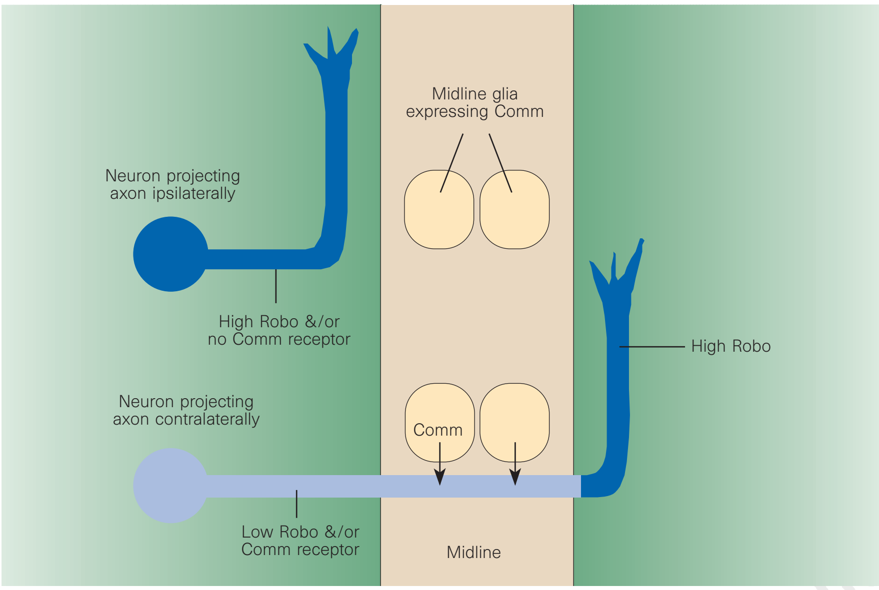

Figure 1 **Model for regulation of midline crossing by axons in the central nervous system of *Drosophila* embryos. The midline is the source of a diffusible attractant (netrins; green) and, as described by Kidd *et al.*[1] and Zallen *et al.*[2], a membrane-bound repellent (the Roundabout or Robo ligand; brown). Axons projecting ipsilaterally (on the side from which they originated) express high levels of Robo (blue), whereas contralaterally projecting axons (on the opposite side) express high levels of Robo only after crossing the midline. The commissureless (Comm) protein (yellow) is transferred from midline glia to commissural axons[13], where Kidd *et al.*[3] have found that it downregulates Robo and thus allows these axons to cross the midline.**

cannot cross the midline in *comm* mutants[9]. The Comm protein is expressed by a group of midline glial cells, positioned exactly where the commissures are pioneered[13]. The protein is transferred to the commissural axons that contact these cells, inhibiting Robo and facilitating passage of these axons across the midline[3,13] (Fig. 1). Because both commissural and longitudinal axons contact these cells, they must differ in their ability to respond to Comm. Kidd *et al.*[3] suggest that commissural axons may initially express lower levels of Robo, so they will be more sensitive to downregulation by Comm. Or, alternatively, perhaps only commissural axons express a Comm receptor.

The high structural and functional conservation in the *netrin* and *robo* families reveals a common underlying logic in the control of axonal traffic by specialized midline structures in the nervous systems of worms, flies, mice and humans — a long-range attractant guides axons to the midline, and a short-range repellent prevents them from crossing it. Commissural axons are granted temporary immunity against this repellent, allowing them just a single pass across the midline.

These studies[1–3] raise many questions. For example, what is the nature of the Robo ligand, the putative midline repellent? How does Comm downregulate Robo, and how is Robo upregulated after the midline crossing? It will also be interesting to find out whether other species use Comm homologues to allow transit across a repulsive midline. Although no vertebrate homologue has yet been reported, a similar mechanism probably conducts commissural axons across the vertebrate floor plate. But as sequencing of the *C. elegans* genome nears completion, it seems that worms lack a *comm* gene, just as their nerve cord lacks commissures.

Evolution seems to have enjoyed a relatively free rein in designing the CNS, coming up with different cellular architectures and developmental strategies in nematodes, arthropods and chordates. One common feature is the organization of axon projections into an orthogonal grid of circumferential and longitudinal nerve fibres. Highly conserved guidance mechanisms employing members of the *netrin* and *robo* families can account for much of this pattern. □

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Daedalus

Keep out the cold

One theory of human evolution is that our ancestors were semi-aquatic apes. They spent so much time in water that they lost their body hair, which impedes swimming. Daedalus points out that in fact, water is a deadly environment for human beings — not by drowning, but by chilling. Our alleged aquatic ancestors should have grown even thicker, longer fur to minimize heat transfer. Indeed, in a maritime accident, it is worth putting on all the clothes you can find; you will live that much longer in the water. As for swimming — forget it. It stirs away all the muscular heat it generates.

Sadly, many sea disasters happen so suddenly that there is no time to look for spare clothes. So Daedalus is devising a nautical uniform which reacts with water to form an ideal survival garment. His first inspiration was the absorptive 'super slurper' acrylate polymer used in bandages and babies' nappies. It can take up hundreds of times its weight of water, expanding into a flabby gel as it does so. In fibrous form, it can be woven into cloth. Underclothes of this fabric would swell in water into a splendid convection-proof wet-suit. But Daedalus's survival suit will not merely insulate; it will actively generate heat. He recalls the immersion batteries on aircraft life-jackets, which use sea water as their electrolyte, and power a signal lamp. His new garment will be one large distributed battery, triggered by immersion in water.

Its electrochemistry is an interesting challenge. At first Daedalus wanted it to generate hydrogen — perhaps enough of it to fill a balloon and lift the wearer out of the water. But more sanely, he now wants it to exploit the high energy of metal oxidation. A distributed zinc–air battery, exploiting the oxygen dissolved in the water, seems best. A few hundred grams of zinc could keep the wearer warm for hours in the coldest water. Hydrogen generated in a side reaction might usefully inflate buoyancy pockets in the garment.

Swollen by gas and absorbed water, the survival suit will usefully discourage attempts to swim. Its wearer may generate a little added heat by shivering, though this also will stir away all the metabolic heat thus mobilized. Only young babies can combat cold by passive thermogenesis. Advocates of our aquatic origins are welcome to the threadbare argument that their ability is a vestigial remnant of our ancestral watery metabolism.

David Jones