VISION

Under the spotlight

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The third, or parietal, eye of lizards and other lower vertebrates mediates the detection of dawn and dusk instead of conventional image-forming vision. The parietal eye photoreceptors resemble their lateral eye counterparts (rods and cones) in morphology, but could produce a hyperpolarizing light response most sensitive to blue light, as well as an unusual depolarizing light response most sensitive to green light — a curious phenomenon known as chromatic antagonism. Writing in *Science*, Chih-Ying Su and colleagues reveal the molecular machinery that underlies these pathways of light detection in the parietal eye.

By screening a parietal eye cDNA library from the side-blotched lizard, the researchers identified pinopsin, the blue-sensitive pigment in rods and cones that is known to drive the hyperpolarizing response, as well as a new pigment, which they named parietopsin. Double immunostaining showed that pinopsin and parietopsin co-localized in the same photoreceptor outer segment, where phototransduction takes place.

The hyperpolarizing response of rods and cones in lateral eyes is mediated by the G protein transducin- α . Interestingly, Su *et al.* found

that photoreceptors in the parietal eye do not contain transducin- α , but express its close relative gustducin- α — the G protein that mediates bitter and sweet transduction in taste buds — as well as $G\alpha_0$, the α -subunit of G_0 . Co-localization studies showed that gustducin- α and $G\alpha_0$ are also expressed in the same photoreceptor outer segment.

The researchers next examined the signalling pathways of light detection in the parietal eye using single-cell recordings. Similar to transducin- α , gustducin- α activates a cyclic GMP (cGMP) phosphodiesterase and closes cGMP-gated cation channels in response to a flash of green light, thereby hyperpolarizing the membrane. By contrast, $G\alpha_0$ inhibits the phosphodiesterase and opens the same ion channels

in response to a flash of blue light, thereby depolarizing the membrane.

The pinopsin–gustducin- α pair is similar to the signalling components in vertebrate rods and cones, whereas the parietopsin– $G\alpha_0$ coupling resembles that in some invertebrate photoreceptors. Therefore, the researchers suggest that the third eye is more primitive, and that image-forming lateral eyes might have evolved from their parietal ancestor but inherited only one G-protein pathway.

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ORIGINAL RESEARCH PAPER Su, C.-Y. *et al.* Parietal-eye phototransduction components and their potential evolutionary implications. *Science* **311**, 1617–1621 (2006)

WEB SITE

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A side-blotched lizard, which has a third, or parietal, eye containing the unusual photoreceptors. Image courtesy of J. Finn and K.-W. Yau, Johns Hopkins University, Maryland, USA.