SENSORY SYSTEMS

Inverting the blues

The colour vision system in most mammals involves blue–green discrimination. In such dichromat animals, opposing signals arising from short wavelength (blue) light-sensitive cones (S-cones) and medium wavelength (green) light-sensitive cones combine to generate blue-On/green-Off and blue-Off/green-On responses in retinal ganglion cells. Blue-On ganglion cell responses are frequently recorded in the retina, and the cellular pathway underlying these responses is well known. By contrast, blue-Off ganglion cells are rarely encountered during recordings, and the cellular basis of the blue-Off response has been unclear. Now, two studies indicate that certain amacrine cells — a diverse class of retinal interneurons that contain >30 distinct types — may have a key role in generating blue-Off signals.

Blue-On signals are conveyed from S-cones to S-On bipolar cells, which send inputs to S-On ganglion cells. An equivalent cellular pathway for blue-Off signals does not seem to exist, as S-Off bipolar cells have not been identified in mammalian retinas. In both studies, the authors hypothesized that amacrine cells, which had previously been thought to have only a minor role in colour processing, could invert signals from S-On bipolar cells to deliver blue-Off signals to ganglion cells. To test this assertion, both groups used the ground squirrel, which harbours cone-rich retinas.

Chen and Li conducted electrophysiological recordings in amacrine cells in retinal slices. They found that a small number of these cells responded to stimuli that selectively activated S-cones, and they called these cells S-cone amacrine cells (SCAs).

Pharmacological blockade of synaptic transmission between S-cones and S-On bipolar cells or between S-On bipolar cells and SCAs inhibited the SCA response to S-cone-selective stimuli, further supporting a role for SCAs in the S-cone pathway. As SCAs are inhibitory neurons (they stained positive for the glycinergic transporter), the authors argued that these cells could deliver blue-Off signals to downstream ganglion cells by inverting excitatory input into inhibitory output.

Sher and DeVries assessed the spiking activity of hundreds of ganglion cells in isolated retinas in response to stimuli of different wavelengths and, in doing so, were able to identify a population of S-Off ganglion cells.

Pharmacological inhibition of S-On bipolar signals blocked the responses recorded in S-Off ganglion cells, indicating that S-Off ganglion cells lie downstream of the S-On bipolar cells in the same cellular pathway.

Interestingly, the application of strychnine, which blocks glycinergic transmission, also inhibited S-Off responses in these ganglion cells, suggesting that glycinergic amacrine cells mediate the signalling between S-On bipolar cells and S-Off ganglion cells.

Together, the results from these two studies place a population of amacrine cells at the heart of blue–green discrimination in the mammalian retina, and dislodge the idea that such cells have little role in colour vision.

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ORIGINAL RESEARCH PAPERS Chen, S. & Li, W. A color-coding amacrine cell may provide a blue-Off signal in a mammalian retina. *Nature Neurosci.* 27 May 2012 (doi:10.1038/nn.3128) | Sher, A. & DeVries, S. H. A non-canonical pathway for mammalian blue–green color vision. *Nature Neurosci.* 27 May 2012 (doi:10.1038/nn.3127)

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