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## Multiple retinal circuits mediate local motion detection

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**Purpose:** In the mouse retina, visual stimulation is encoded by two photoreceptor types, rods and cones. Rods mediate vision in dim light, however in the mouse retina, there is growing evidence that they also encode information at bright light. The majority of mouse photoreceptors contain two opsins with peak sensitivity in the UV (360 nm, s-opsin) and green (508 nm, M-opsin). The ratio of these two opsins varies across the retina such that in ventral retina, cone photoreceptors are dominated by s-opsin while dorsal cone photoreceptors are dominated by M-opsin. Here we compare the organization and development of rod and s-cone mediated contributions to direction selectivity.

**Methods:** Using two-photon targeted patching, we assessed the directional tuning of GFP+ On-Off DSGCs using cell-attached and whole-cell voltage clamp recordings. Recordings were confined to the ventral half of the retina, where cones were selectively stimulated with 385 nm light and rods with 520 nm light.

**Results:** In adult retina, both On and Off spiking responses were directionally selective (DS) to both cone and rod stimulation. Interestingly, we found that the Off responses for s-cone mediated DS were more poorly tuned than On responses, while the Off responses for rod mediated DS were similarly tuned to the On responses. Voltage clamp recordings showed also that inhibitory inputs to DSGCs were also directionally tuned, with the strongest inhibitory currents detected for motion in the null direction, while excitatory inputs had equal amplitude for motion in all directions. The rod and cone mediated pathways had different developmental time courses. Prior to eye opening (postnatal day, P11), while the ON responses were tuned for both rod and cone stimulation, there was a significant difference in tuning for Off pathways. Notably only 20% of the DSGCs exhibited directional tuning in their Off response to cone stimulation while 80% of the DSGCs exhibited directional tuning in their Off response to rod stimulation. The decreased DS tuning in the cone pathway was due to an increased action potential firing to null-side stimulation.

**Conclusions:** Our data indicates that direction selectivity is computed for both rod and cone pathways, albeit via distinct circuits. The Off channel represents an important point of divergence between cone and rod-pathway both in its strength of tuning and developmental time course. These data indicate that the retina uses multiple strategies for computing direction-selective responses across different stimulus conditions.