SUPPLEMENTARY INFORMATION

Synaptic mechanisms of adaptation and sensitization in the retina

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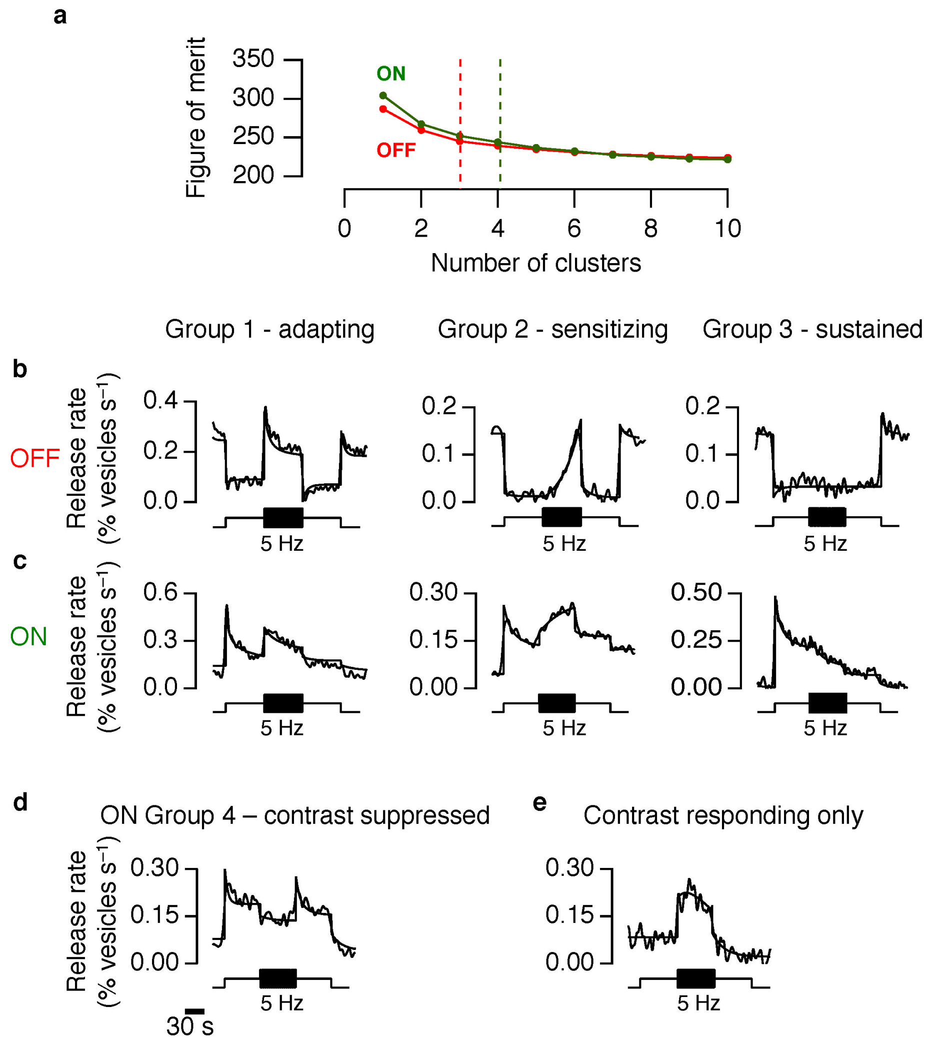
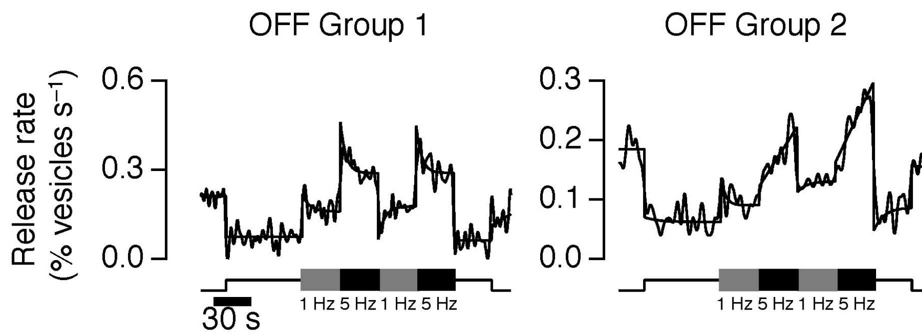


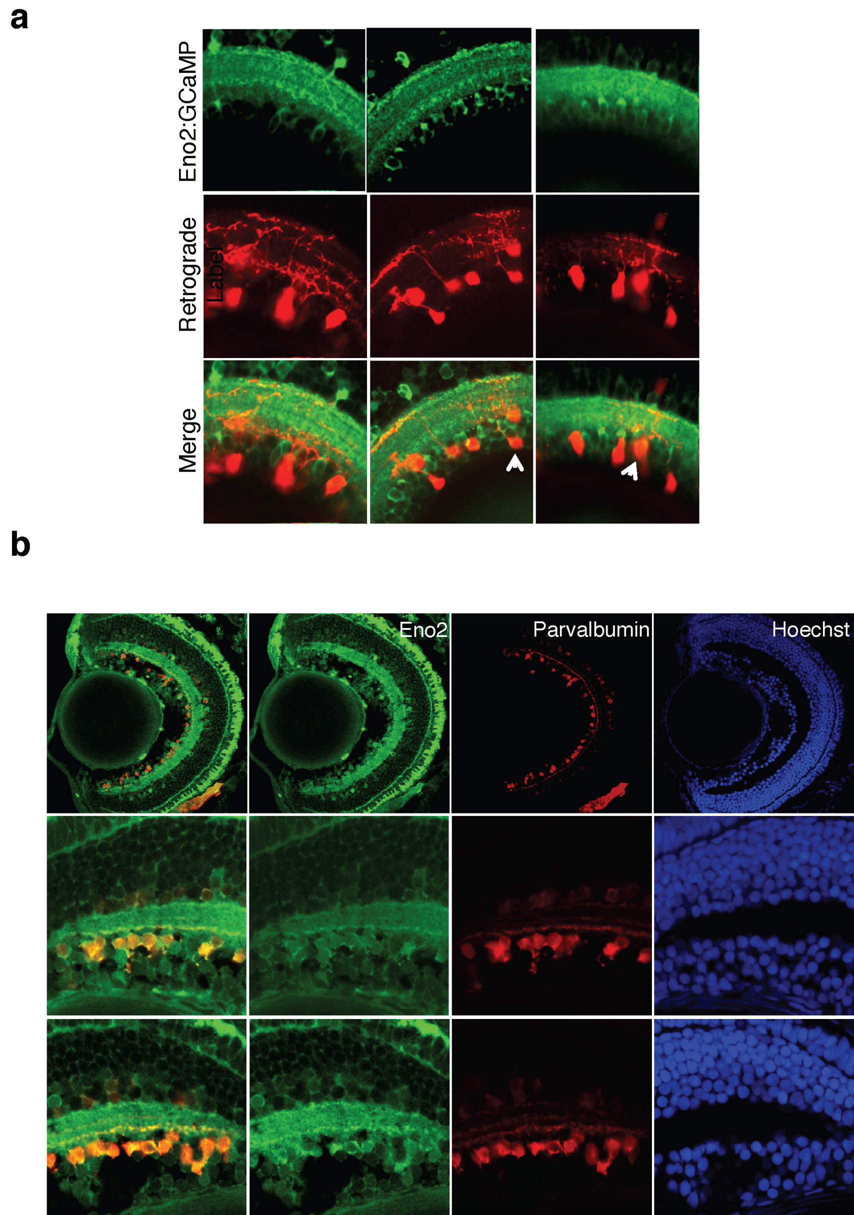
Supplementary Figure 1. Synaptic transmission from different functional groups of bipolar cell terminals recognized by clustering. This figure expands on the results shown in Figure 1. Each graph plots the averaged sypHy trace within each cluster converted into relative rates of vesicle release, either directly (noisy traces) or after applying a series of exponential fits (smooth traces). First, terminals were separated into OFF (**b**) or ON (**c, d**) classes, according to the response to a full-field step of light. A subpopulation of terminals (**e**) did not generate a significant response to the light step, but did respond to modulation of intensity at 5 Hz and 100% contrast (applied during the black bar).

(**a**) Figure of merit calculated for OFF (red) and ON (green) terminals is smooth and does not reveal distinct classes of responses but stops decaying after 3-4 classes. **(b)** The clustering algorithm separated OFF terminals into three groups, in which a key distinguishing feature was the response to contrast: depressing, facilitating and insensitive. (**c**) The clustering algorithm also separated ON terminals into depressing, facilitating and insensitive groups.

(**d**) A fourth group of ON terminals could be recognized, which were suppressed by this 5 Hz stimulus (n=40 terminals, 7 fish). (**e**) Terminals responding to contrast only did not obviously facilitate or depress (n=40 terminals, 7 fish). All error bars are s.e.m.



Supplementary Figure 2. Frequency-dependent plasticity of the signal that bipolar cells transmit to the inner retina.
This figure expands on the results shown in Figure 3, and illustrates averaged exocytic responses from band-pass terminals in OFF Groups 1 and 2 (n=43 and 36 terminals, 5 fish). In OFF Group 1, terminals depress during the response at both frequencies, but in OFF Group 2 they facilitate at 5 Hz. The frequency was stepped from 1 Hz to 5 Hz on two occasions. Note the reproducibility of the responses. Release rates were calculated from sypHy traces either directly (noisy traces) or after applying a series of exponential fits (smooth traces). All error bars are s.e.m.



Supplementary Figure 3. Characterization of *eno2*:GCaMP3.5 fish.
(**a**) Three examples of IPL of three different fish expressing GCaMP3.5 under *eno2* promoter (green) and correlation with retrograde labeling of ganglion cells (See supplementary information). This data demonstrates that eno2:GCaMP2 fish expresses reporter in ganglion cells. (**b**) Some amacrine cells also express GCaMP2. Figure demonstrates co-labeling of eno2:GCaMP3.5 and Parvalbumin, a marker of amacrine cells.

Supplementary Movie 1. In vivo imaging of synaptic transmission from bipolar cells responding to contrast.

This movie is from the experiment analyzed in Figure 1A. The relative change in fluorescence dynamics ($\Delta F/F_0$) is shown on a pseudo-color scale for each ROI, where warmer colors represent stronger increases in sypHy fluorescence and colder colors represent falls. Real-time. Scale bar is 20 μm.