In V1 duplex cells, the form of responses to gratings depends on temporal frequency

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Abstract

Our earlier studies have shown that responses to gratings of "duplex" cells, the dominant type in V1 of alert monkeys, are diverse and can not be predicted from receptive fields' spatial maps. These cells have overlapping increment and decrement activating regions (ARs), but many have a significant fundamental (F1) harmonic in the responses to drifting sinusoidal luminance gratings. Conversely, transient stimuli, such as flashing bars and counterphase gratings, mostly evoke on-off, or frequency doubled (second harmonic, F2) responses. This mixture of "linear" and "nonlinear" properties suggests that the temporal dynamics of interactions between increment and decrement ARs and the suppressive surround play an important role in shaping duplex cells responses. Therefore, in this study we used gratings of varying temporal frequency to study the responses of duplex cells in parafoveal V1 of a monkey performing a fixation task. We found that many cells responded with a significant linear (F1) modulation to high temporal frequency gratings, but show frequency doubled (F2) responses at low temporal frequencies. This temporal frequency-dependent F2 modulation differs from low spatial frequency doubling that we observed in a large portion of duplex cells. These results reveal an elaborate spatiotemporal structure of duplex receptive fields.

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