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# Velocity preferences of simple and complex cells in the cat's striate cortex

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Hubel & Wiesel's (1962) basic hierarchical model of visual cortical function, in which simple cells drive complex cells directly, has recently been criticized (see Stone, 1972). The responses of cortical cells to moving stimuli are relevant to this issue.

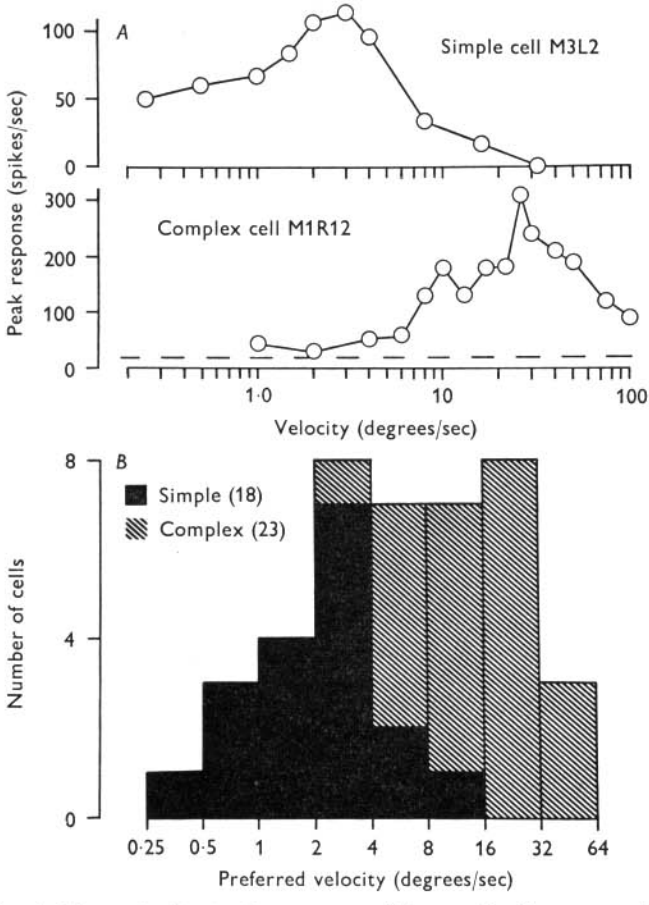


Fig. 1. *A*, The velocity tuning curves of two cells from area 17. The stimulus for both cells was a light bar, $4° \times \frac{1}{4}°$ for the simple cell, and $10° \times \frac{1}{2}°$ for the complex cell. The dashed line indicates the spontaneous activity of the complex cell (18 spikes/sec). *B*, Histogram showing the preferred velocities of forty-one cells from area 17. Solid blocks are simple cells, cross-hatched are complex.

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Cats were prepared for recording from single units in area 17 using conventional methods (Rose & Blakemore, 1974). Receptive fields were initially analysed with flashing and moving stimuli projected on a tangent screen, and classified by the criteria of Hubel & Wiesel (1962), as summarized by Blakemore, Fiorentini & Maffei (1972). Light or dark bars, or edges, optimized for size, orientation and direction of movement, were then generated on a display oscilloscope using a television technique. Stimulus sweeps gated a multichannel averager (Biomac 1000) to produce smoothed pulse density histograms.

Fig. 1*A* shows the velocity 'tuning curves' of two typical cells: the preferred velocity of the complex cell (24 deg. $sec^{-1}$) is higher than that of the simple cell (3 deg. $sec^{-1}$). Fig. 1*B* shows the preferred velocities of forty-one cells. The distributions of simple and complex cells are clearly different, and inspection of the tuning curves (e.g. Fig. 1*A*) shows that most complex cells respond briskly to high velocities (in excess of 40 deg. $sec^{-1}$) to which simple cells respond poorly if at all. These results confirm and extend those of Pettigrew, Nikara & Bishop (1968), who used different criteria for classifying cells and for assessing responses, but differ from theirs in some important respects.

Some complex cells (4 of 23) showed a secondary response peak in the region of 1–4 deg. $sec^{-1}$, which may indicate that they receive some input from simple cells. But it seems clear that their primary excitatory input must come from elsewhere.

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REFERENCES

Blakemore, C., Fiore tini, A. & Maffei, L. (1972). *J. Physiol.* **226**, 725–749.
Hubel, D. H. & Wiesel, T. N. (1962). *J. Physiol.* **160**, 106–154.
Pettigrew, J. D., Nikara, T. & Bishop, P. O. (1968). *Expl Brain Res.* **6**, 373–390.
Rose, D. & Blakemore, C. (1974). *Expl Brain Res.* **20**, 1–17.
Stone, J. (1972). *Invest. Ophthal.* **11**, 338–344.