

MODELLING DENDRITIC GROWTH OF RETINAL GANGLION CELLS

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Retinal ganglion cells of any one type spread their dendrites in a single layer. Wässle et al (1981) showed that the dendritic trees occupy Voronoi tiles drawn around the ganglion cell bodies. There is little overlap between adjacent trees. They suggested a growth model in which dendrites:

- 1) all start growing at the same time;
- 2) all grow at the same rate;
- 3) stop growing when they touch a neighbouring cell's dendrites.

Since for each type of ganglion cell the growth is essentially planar, it is possible to model it on a computer screen to find out if these rules are sufficient to specify the sorts of dendritic trees that are found in vivo.

Here it is shown that indeed the rules are adequate and provide a useful teaching device. Moreover the elongation of dendritic trees on the edge of an area of cell loss is also partly mimicked (Perry & Linden, 1982)

Input parameters are mean cell separation and branch length. When these are varied the amount of invasion of an adjacent cell's territory is changed. If the distance between branches is more than about 20% of the minimum distance between adjacent cells then about half of a cell's dendrites are in its neighbour's territory. When the distance between branching is shorter there are more dendrites at the periphery of a tile which reduces the possibility of a neighbour's invasion. If the branching frequency is characteristic of the ganglion cells of any one type then in the periphery of the retina where the ganglion cells are further apart there should be less of a cell's dendritic tree in the territory of its neighbours. This prediction is a crucial test of the model.

Computer modelling is valuable in three ways. One is that dynamic processes can be demonstrated and this is important pedagogically and the second is that the programming encourages rather precise specification of the necessary and sufficient biological rules. Finally, predictions may emerge to guide further investigations.

References:

- Perry, V.H. & Linden, R. Evidence for dendritic competition in the developing retina. *Nature* 1982; 297: 683-685.
- Wässle, H., Peichl, L., Boycott, B.B. Dendritic territories of cat retinal ganglion cells. *Nature* 1981; 292: 344-345.