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Gating effects along mitral cell lateral dendrites

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Background

It is generally thought that granule-mitral cell synapses in the olfactory bulb function to inhibit mitral cell firing, and that this inhibition can underlie such functionally important phenomena as lateral inhibition and synchronization [1]. Recent electrophysiology [2] and imaging [3] studies indicate that the location of the dendrodendritic synapse must be close to the soma to impact the mitral cell's firing.

Materials and methods

Our objective was to survey the effect of dendrodendritic synapses on firing of pairs of mitral cells sharing a granule cell using a standard, computational mitral cell model [4].

Results

We show that depending on the location of the dendrodendritic synapses along the mitral cell lateral dendrite, three types of inhibitory effects can be described between mitral cell pairs: 1) A "bidirectional gate" arises when the granule cell induces a discernible inhibitory response in both mitral cell somas. 2) A "unidirectional gate" occurs when the granule cell induces a discernible inhibitory response in only one mitral cell soma. 3) An "inconsequential gate" occurs when the granule cell does not induce a discernible inhibitory response in either mitral cell soma.

Conclusion

Preliminary results indicate that most of the lateral dendrite contains unidirectional or inconsequential gates. This is important as most olfactory bulb models effectively treat the mitral-granule dendrodendritic synapse as a bidirectional gate and may need to account for other gating behaviors created by considering the spatial extent of dendrodendritic synapses.

References

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