Dendritic computation

Dendrites as computational elements:

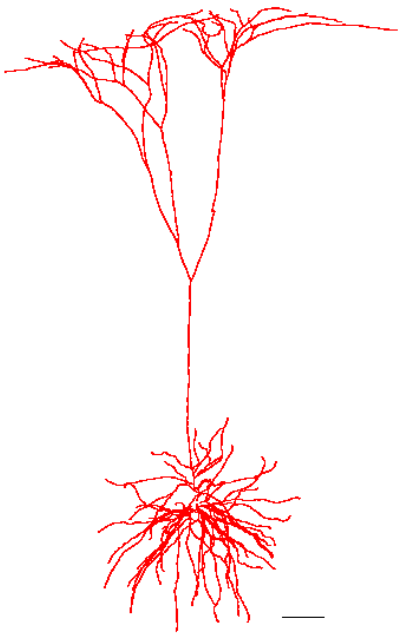
Passive contributions to computation

Active contributions to computation

Examples

Passive computations

Linear filtering:



→ Inputs from dendrites are broadened and delayed

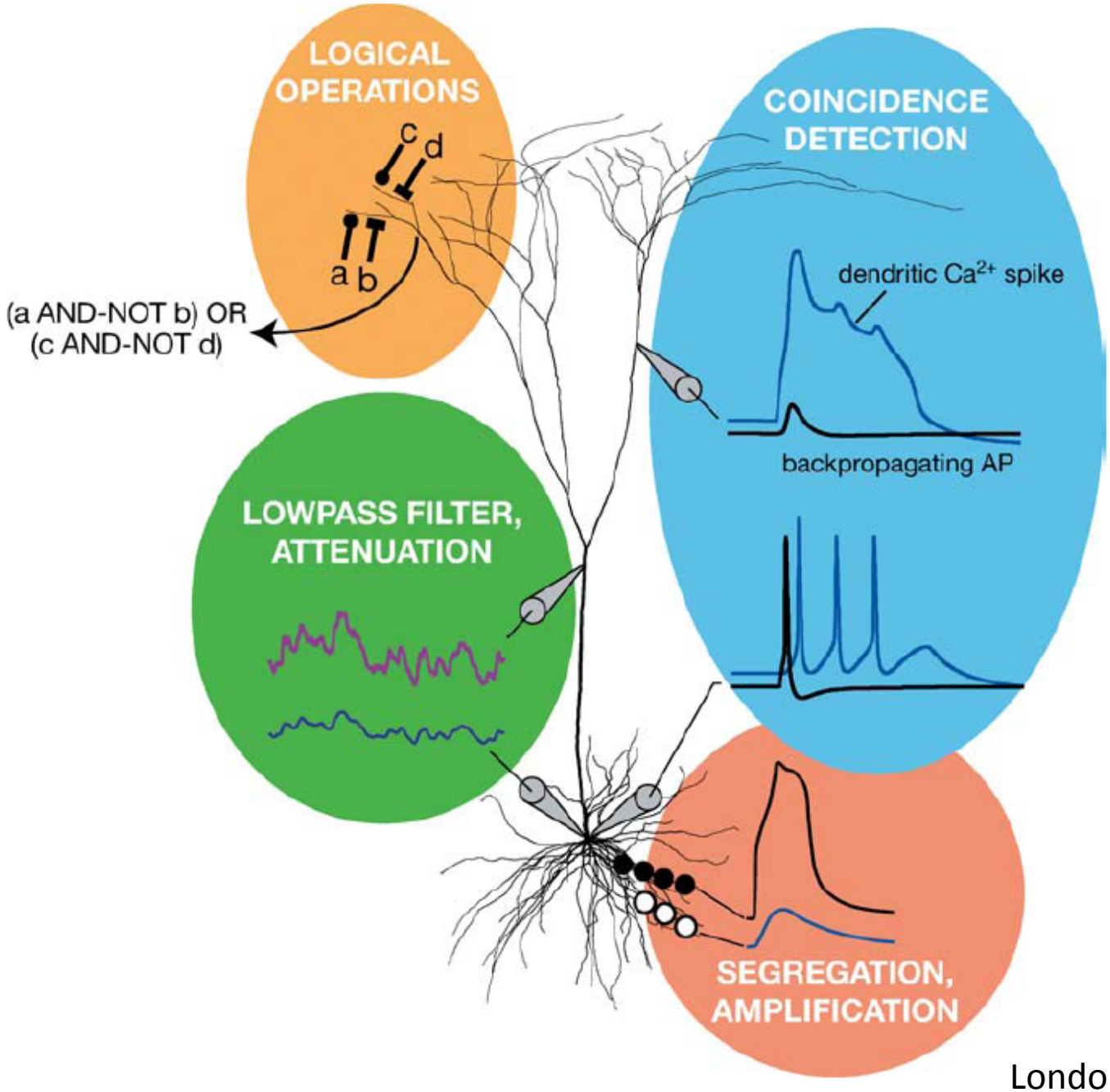
→ Alters summation properties..
coincidence detection to temporal integration

→ Delay lines

→ Segregation of inputs

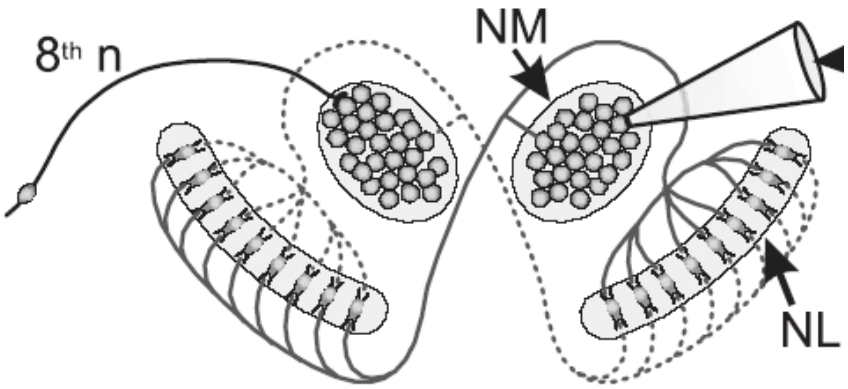
→ Nonlinear interactions within a dendrite
-- sublinear summation
-- shunting inhibition

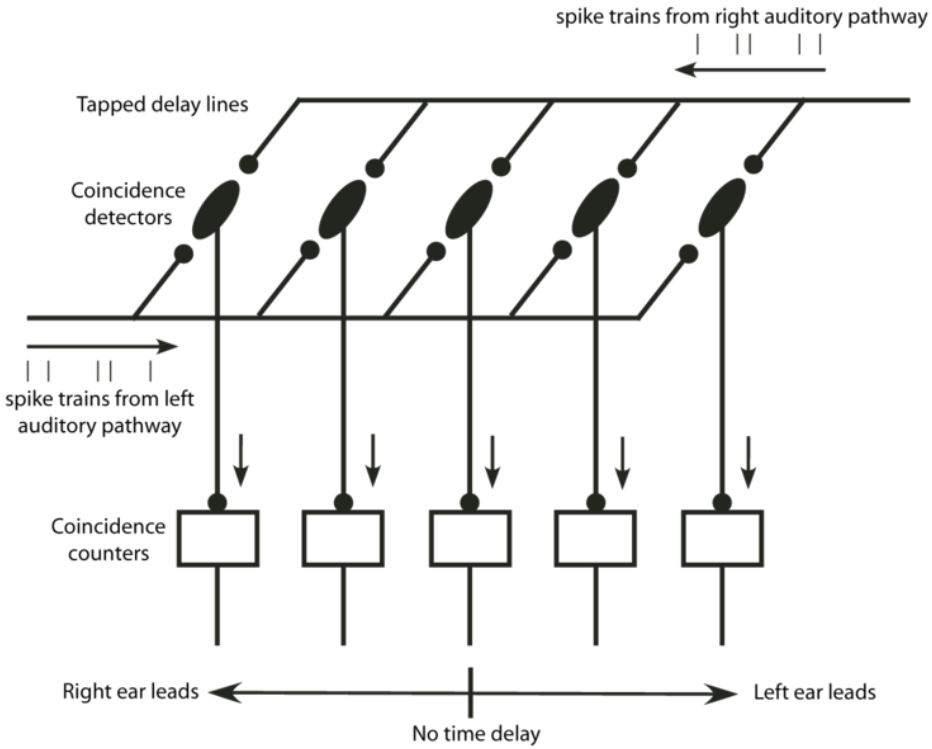
→ Dendritic inputs “labelled”



London and Hausser, 2005

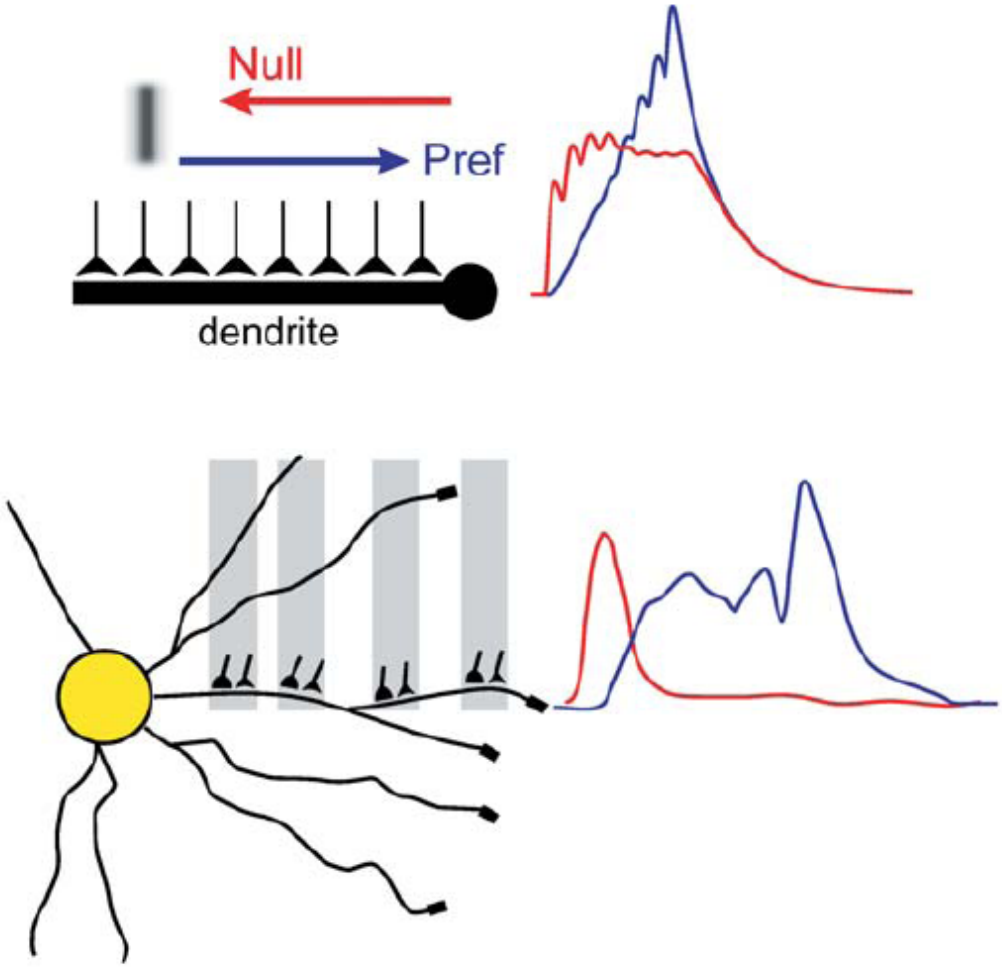
Delay lines: the sound localization circuit



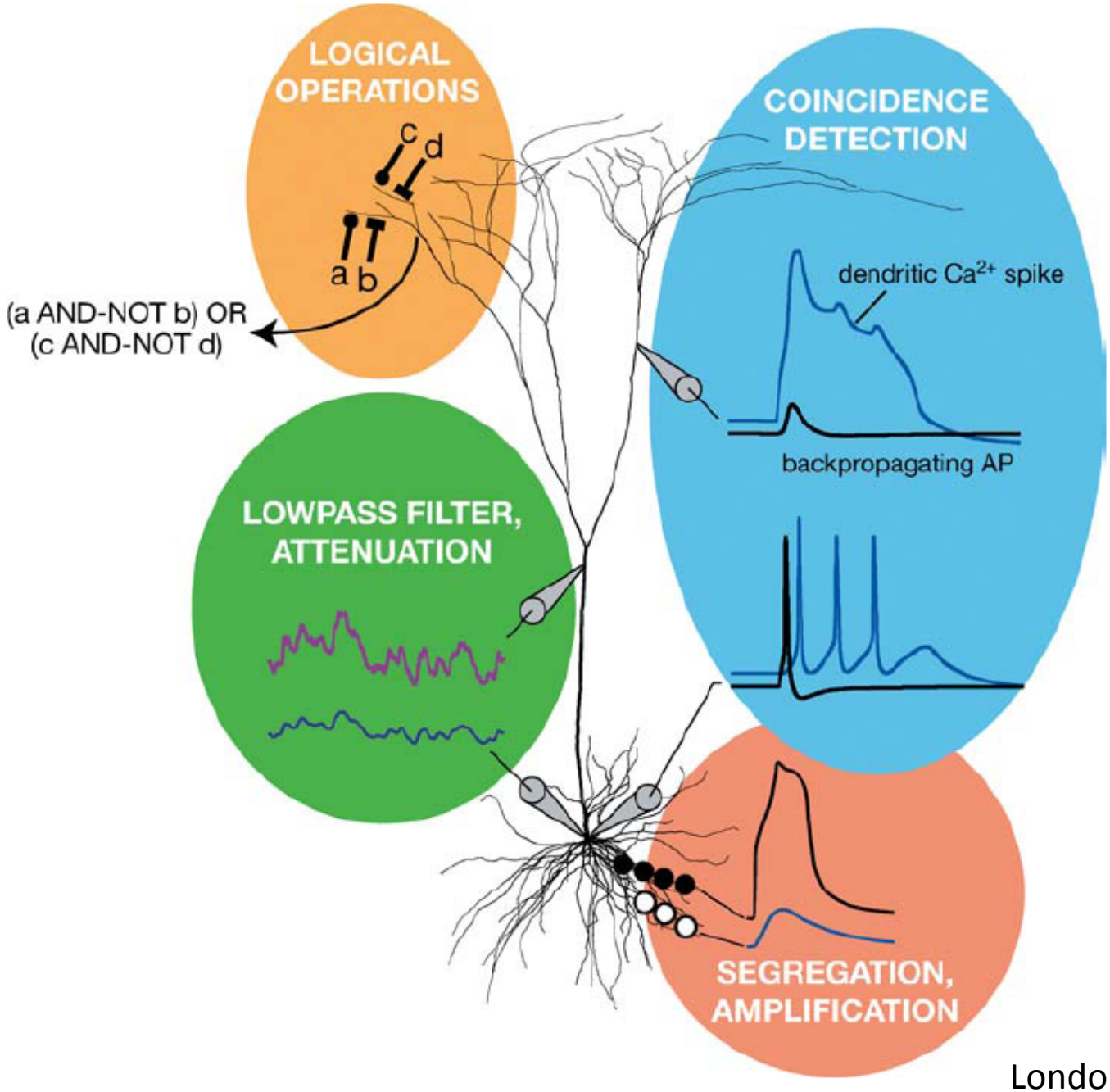


Spain; Scholarpedia

Direction selectivity



Rall; fig London and Hausser



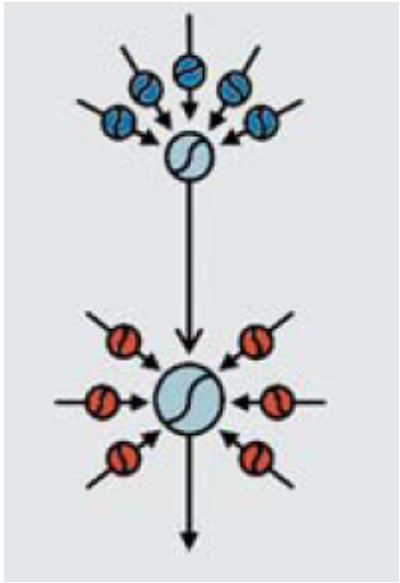
London and Hausser, 2005

Active dendrites

Mechanisms to deal with the distance dependence of PSP size

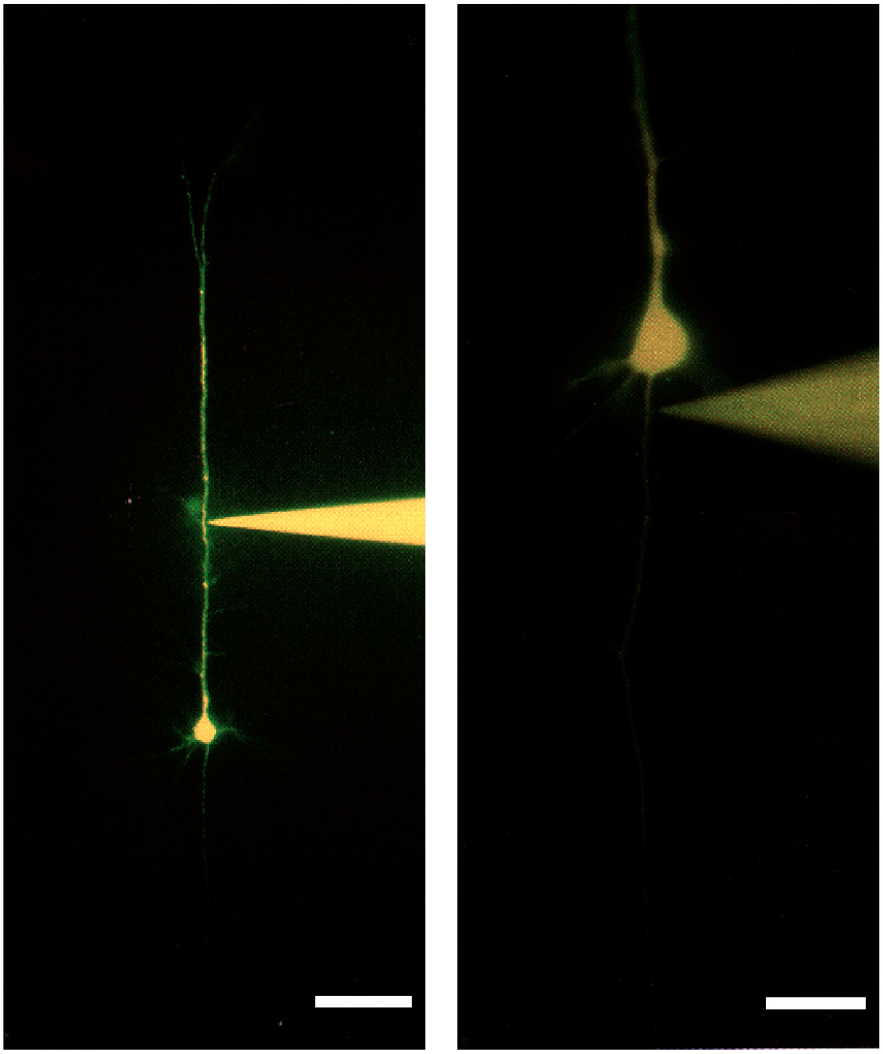
→ Subthreshold boosting: inward currents with reversal near rest
Eg persistent Na^+

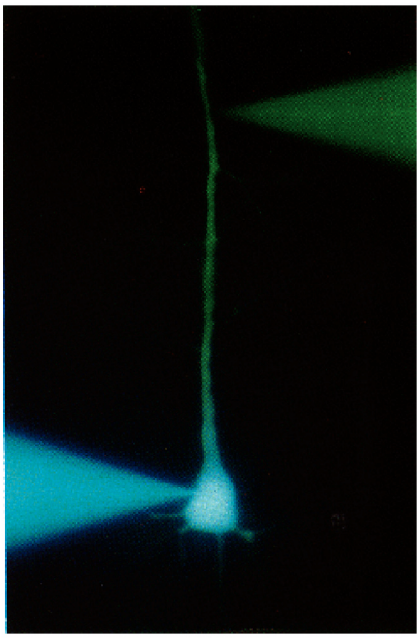
→ Synaptic scaling

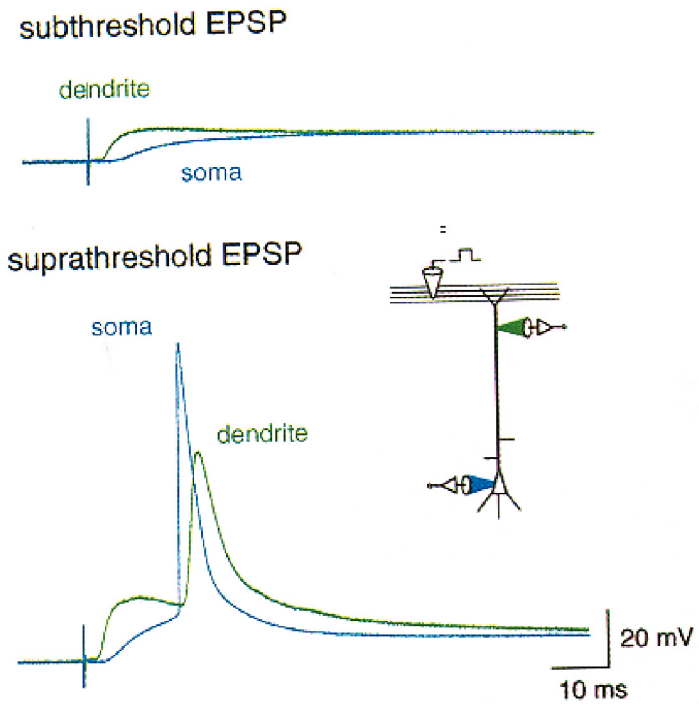


→ Dendritic spikes
Na^+, Ca^{2+} and NMDA
Dendritic branches as
mini computational units

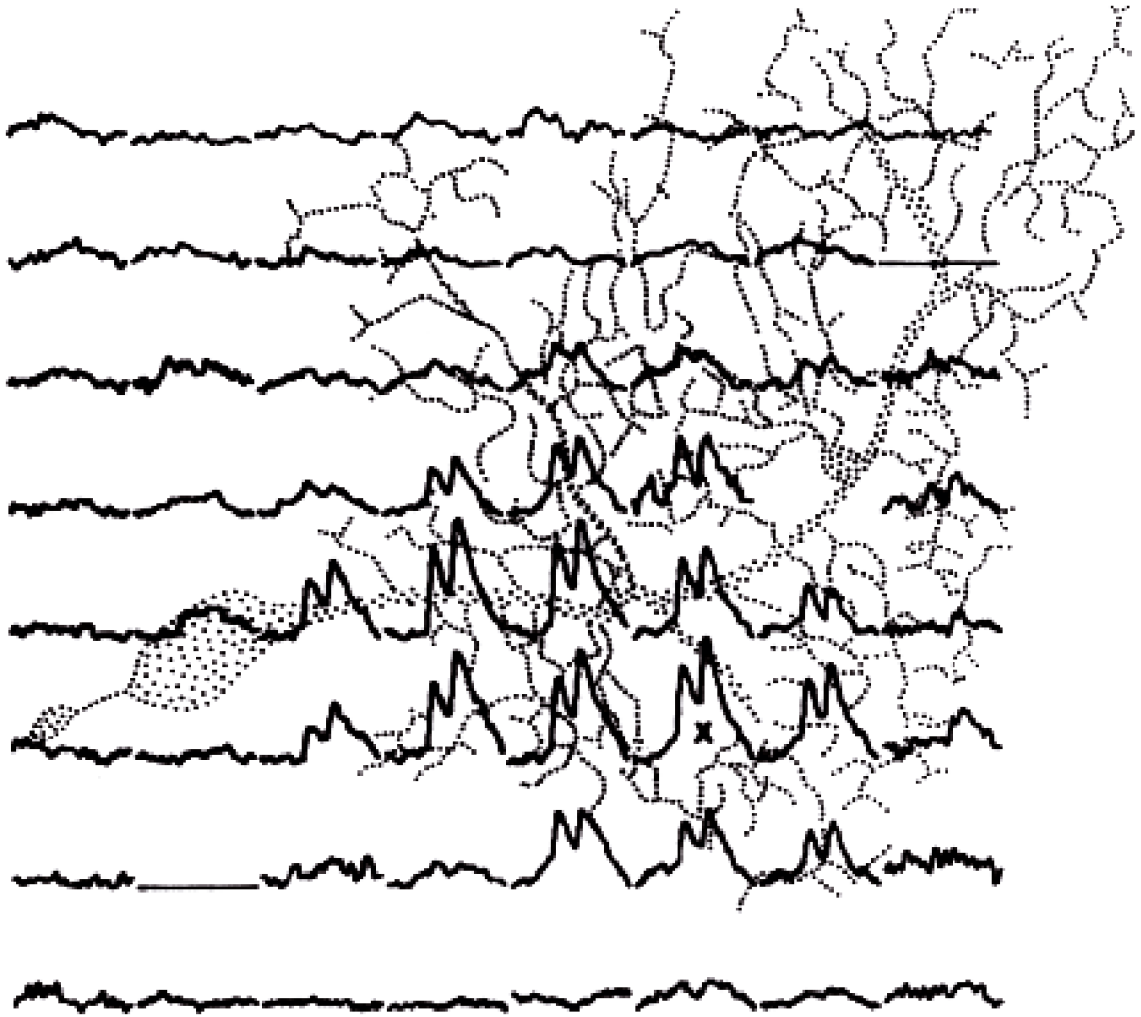
→ backpropagation:
feedback circuit
Hebbian learning through
supralinear interaction of backprop spikes with inputs

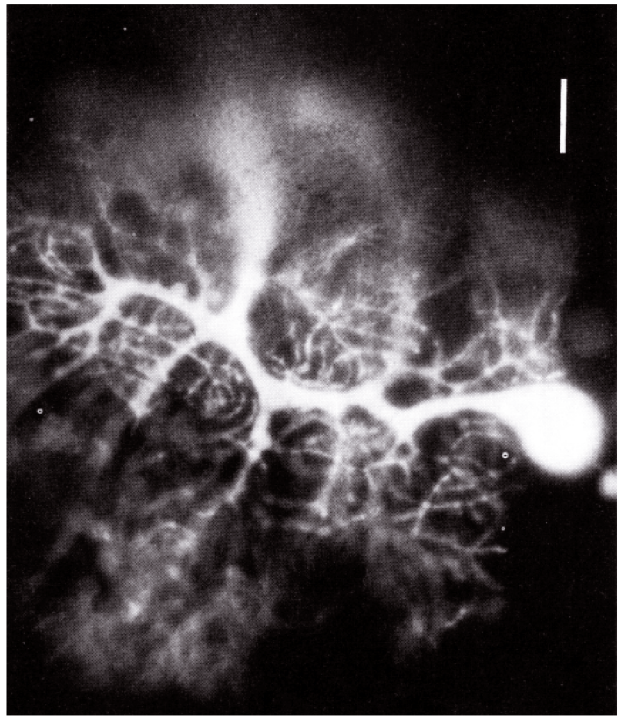


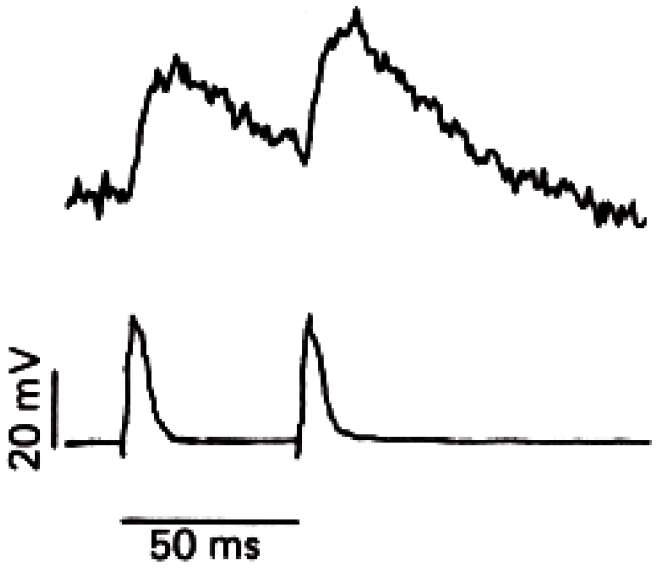




chapt_6_sackmann.eps







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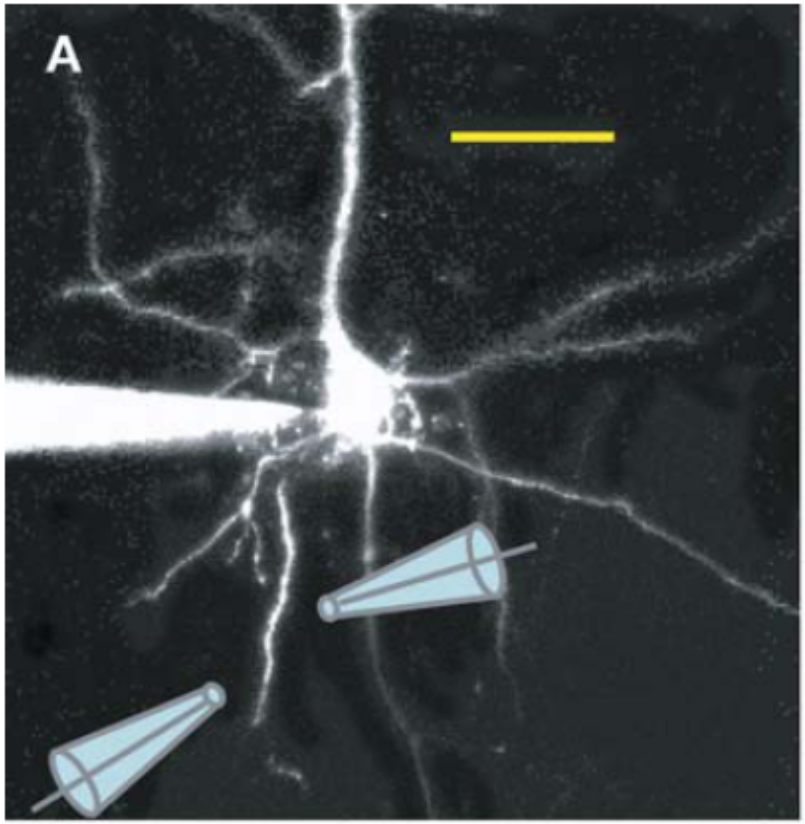
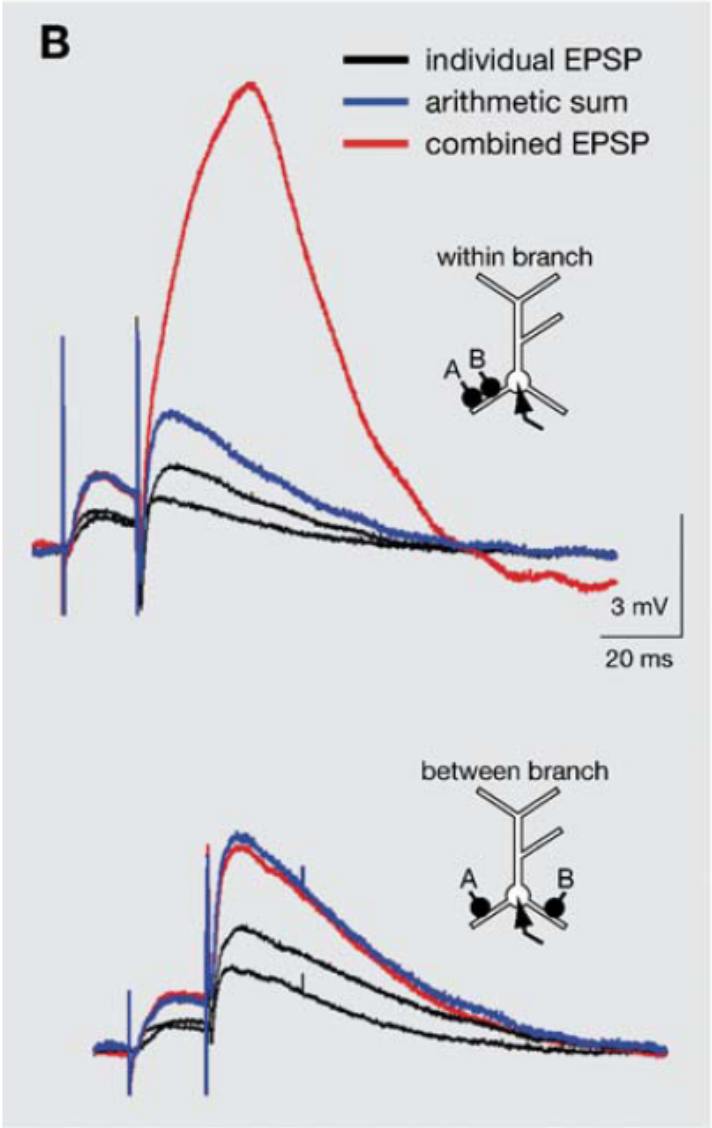
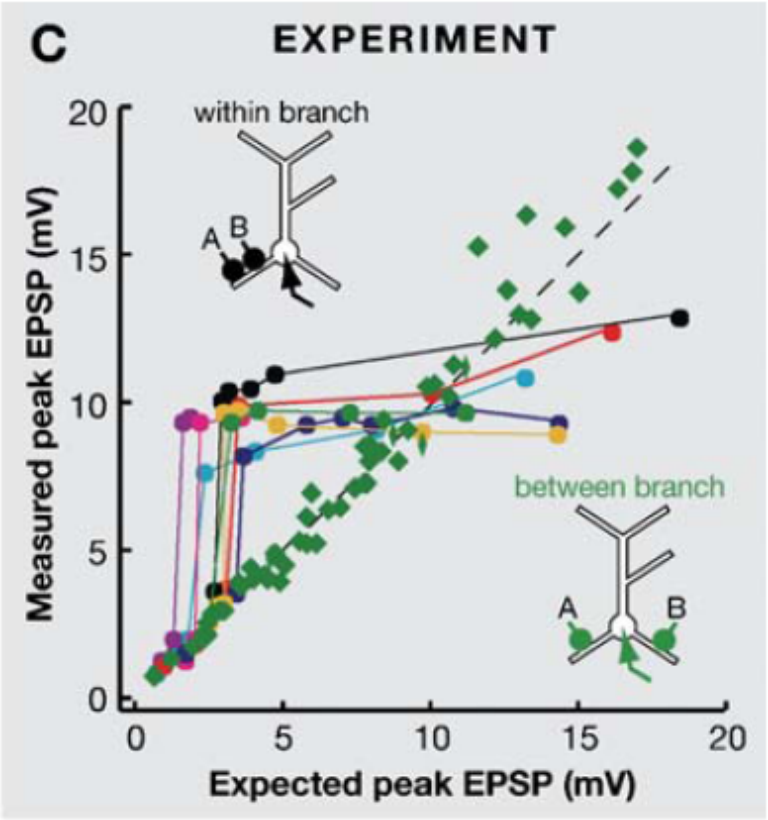
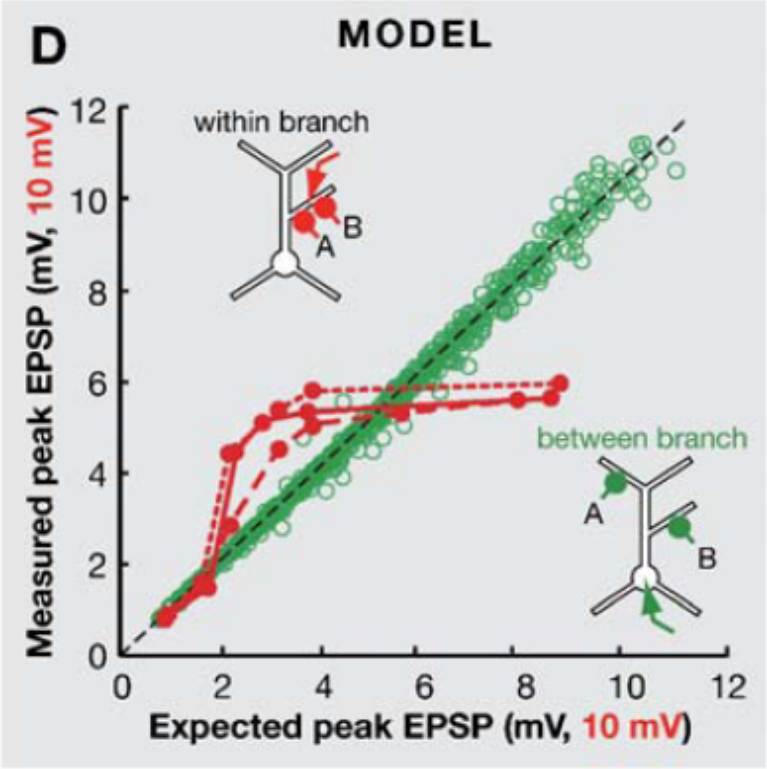
Segregation and amplification



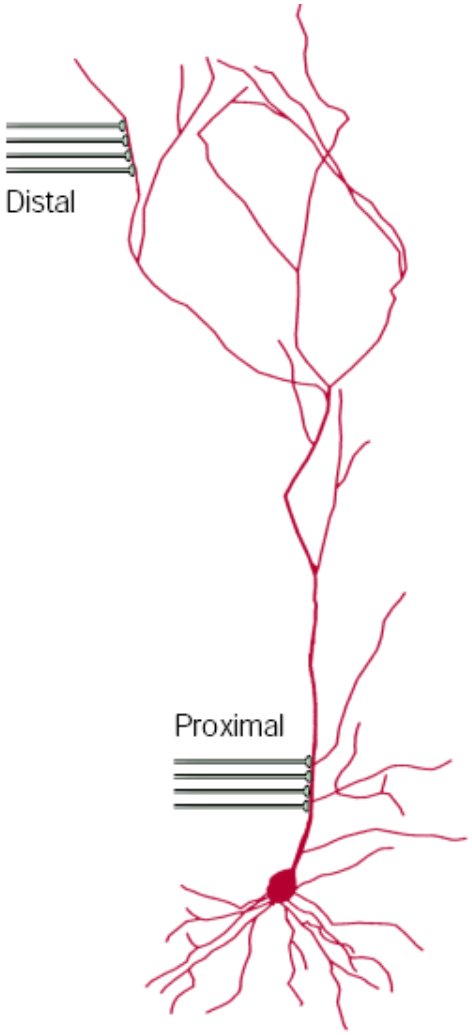


Segregation and amplification

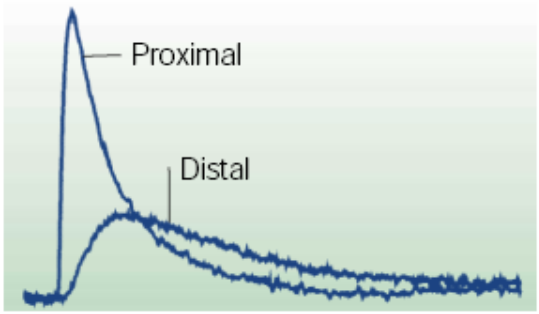




Expected distance dependence

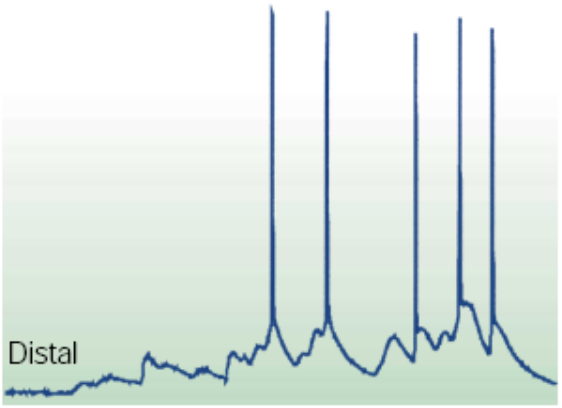


Localized output

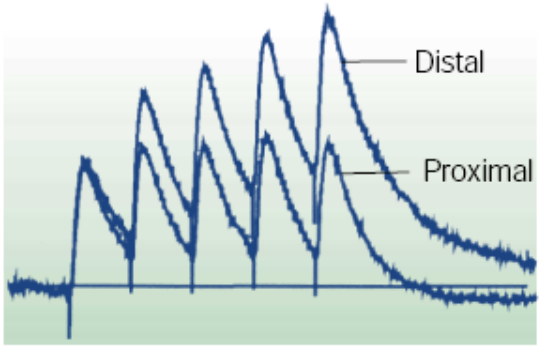


Amplitude and kinetics

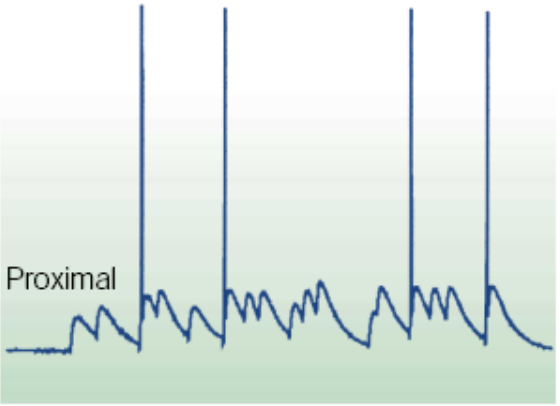
Synaptic potentials



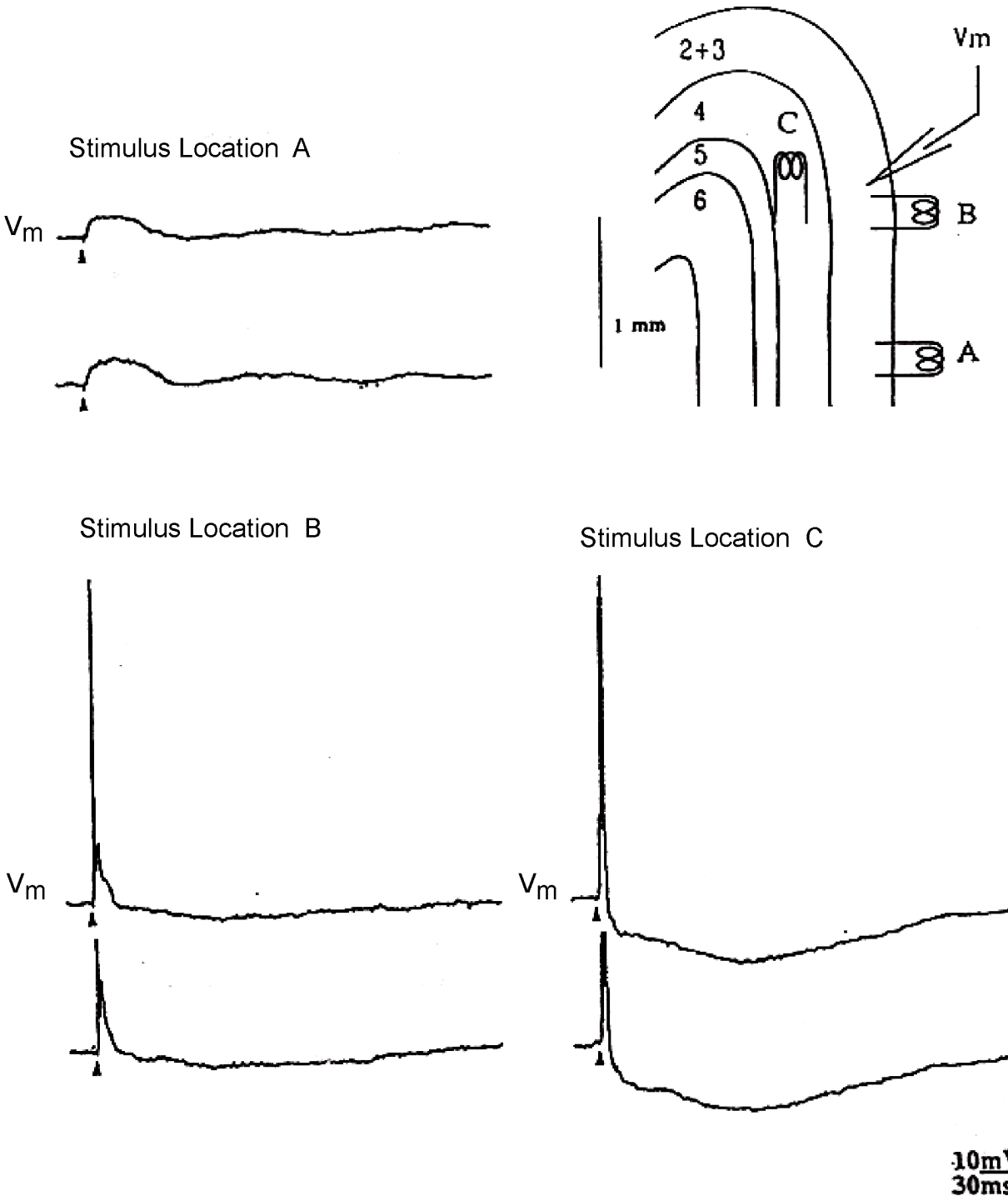
Somatic action potentials



Temporal summation



Magee, 2000



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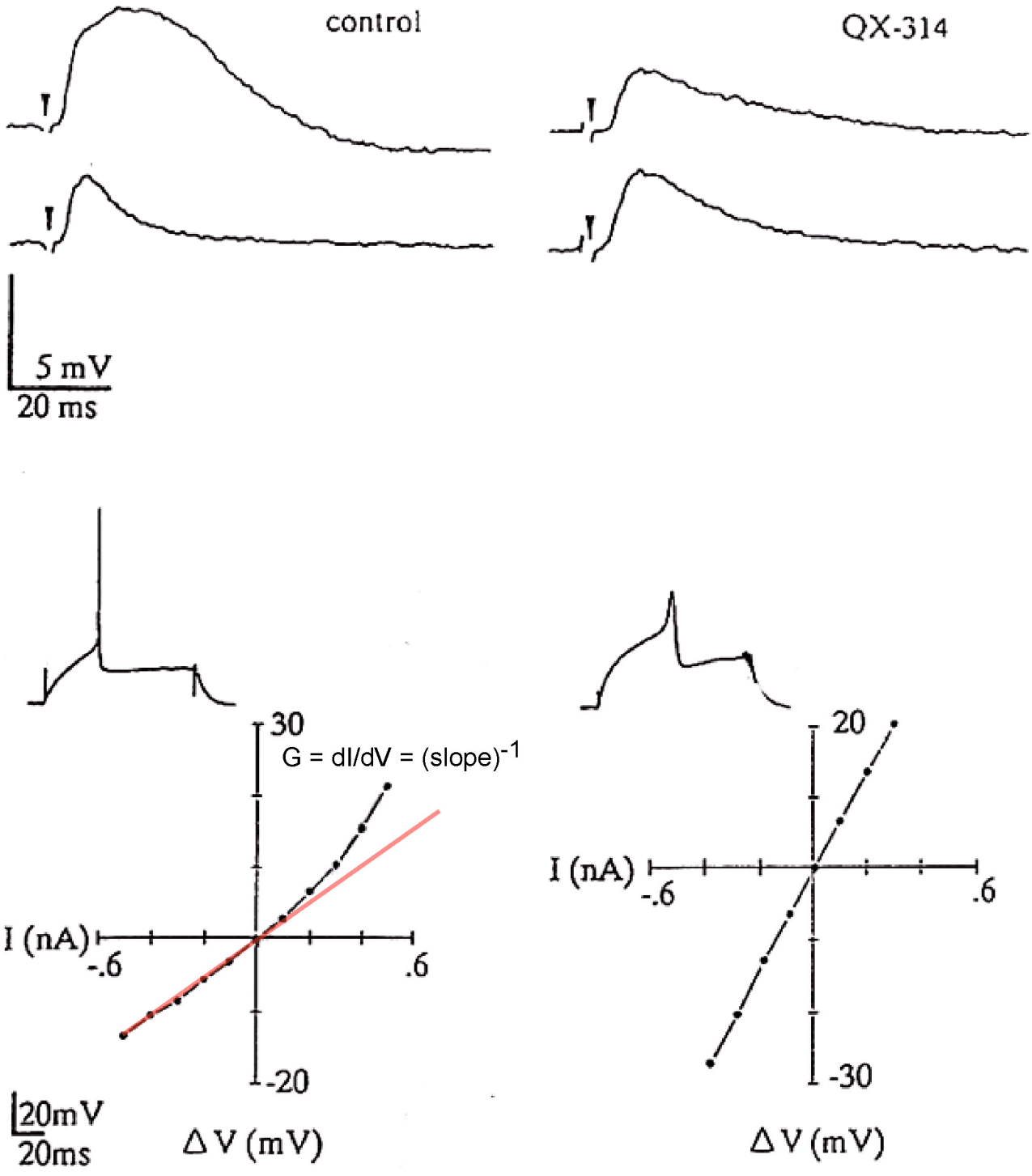

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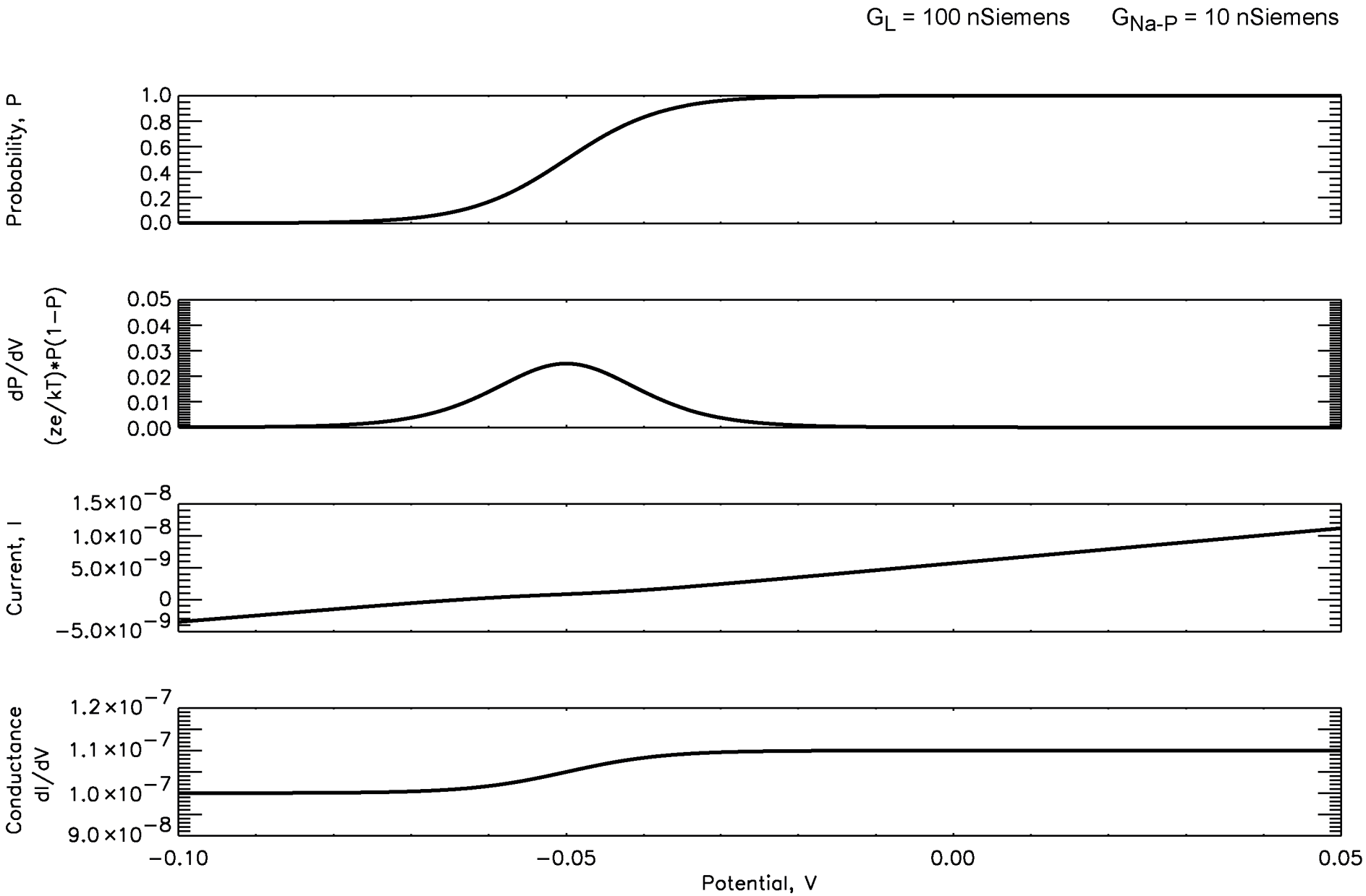

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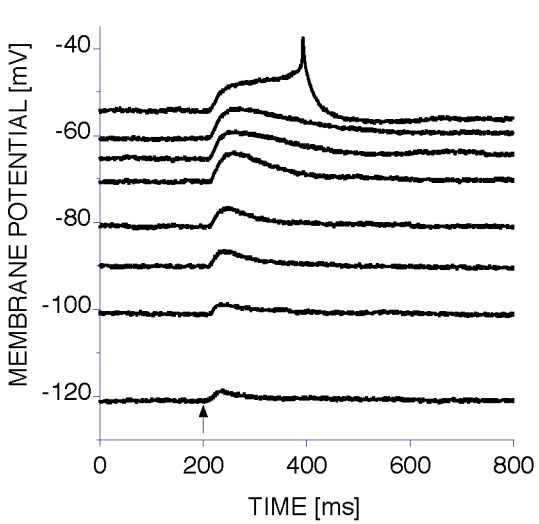

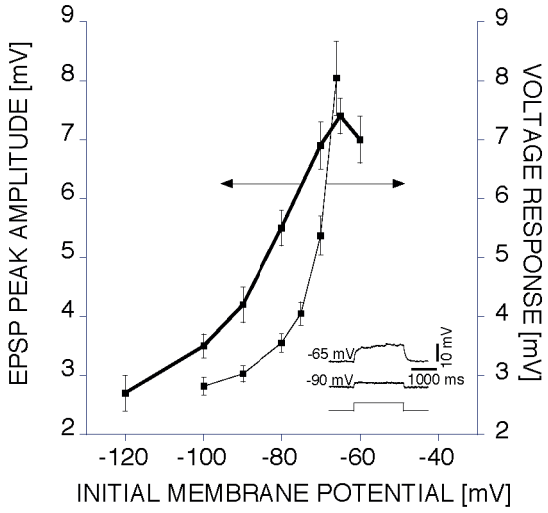

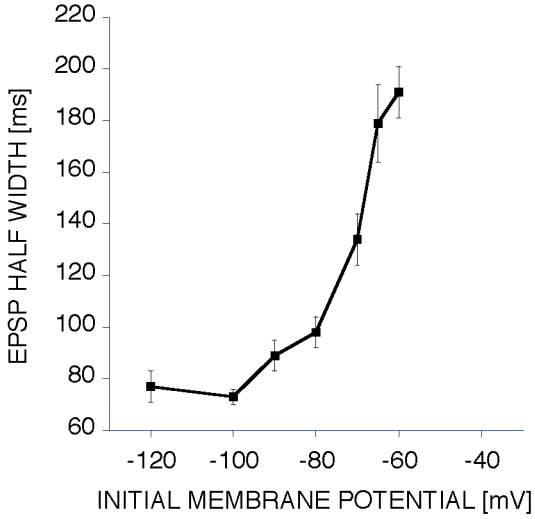

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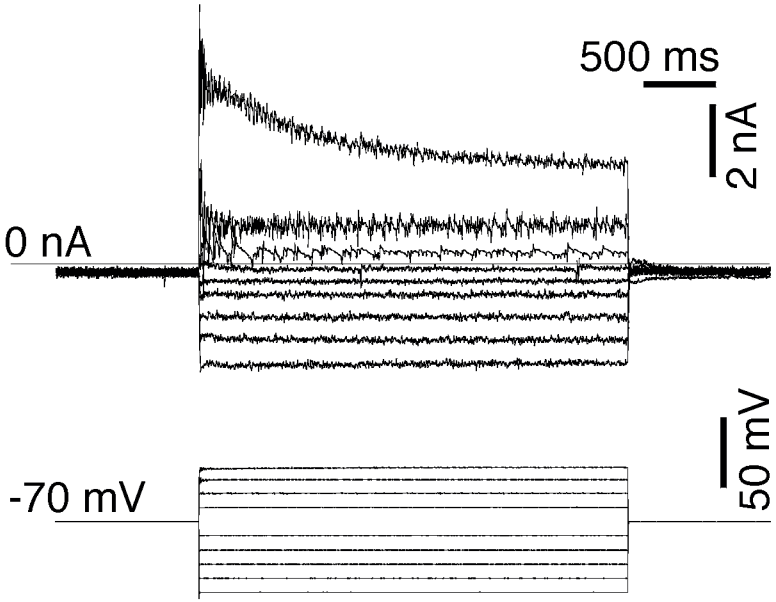

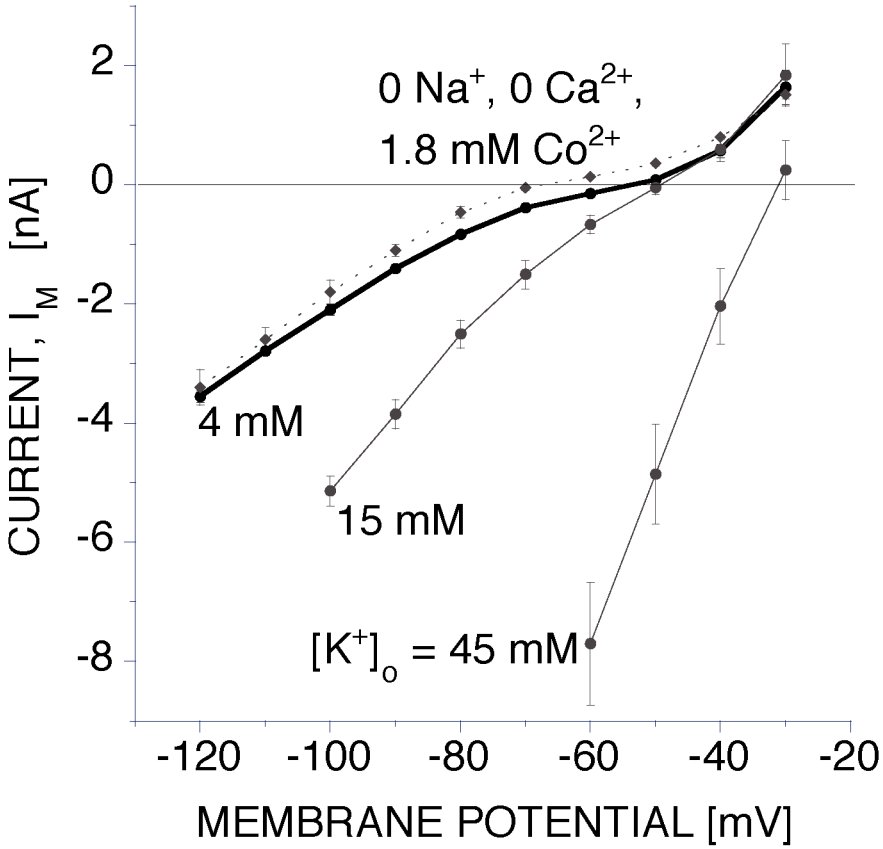

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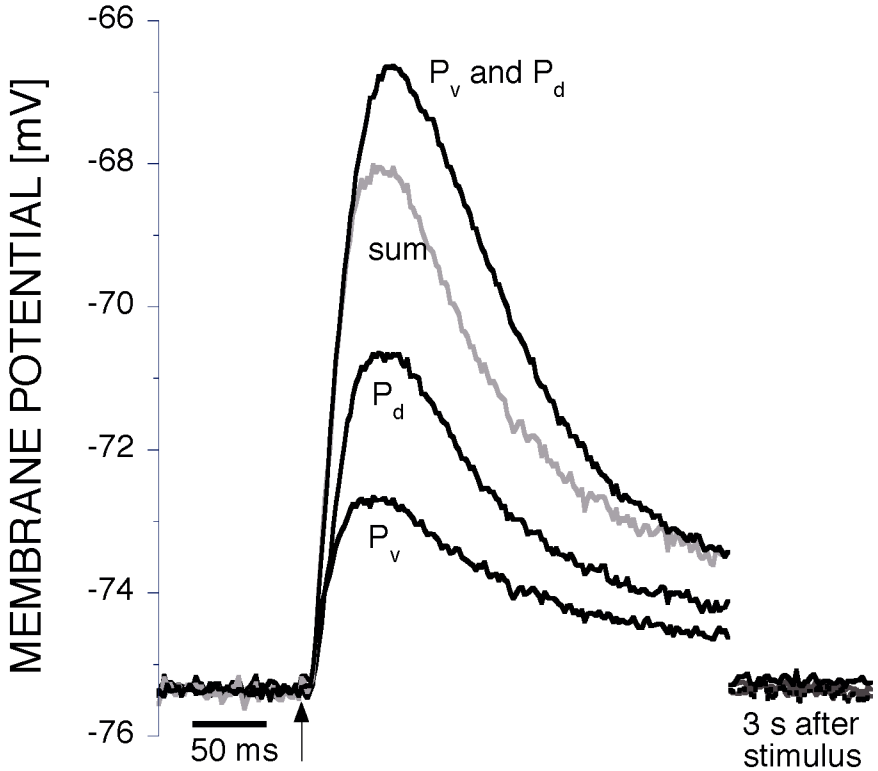

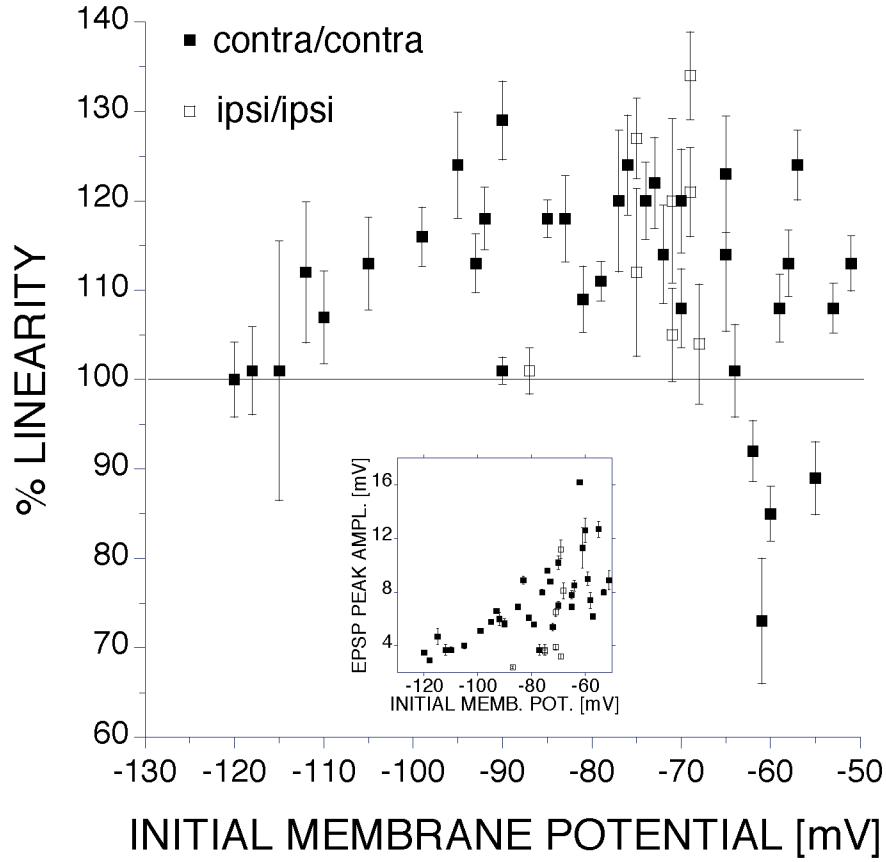

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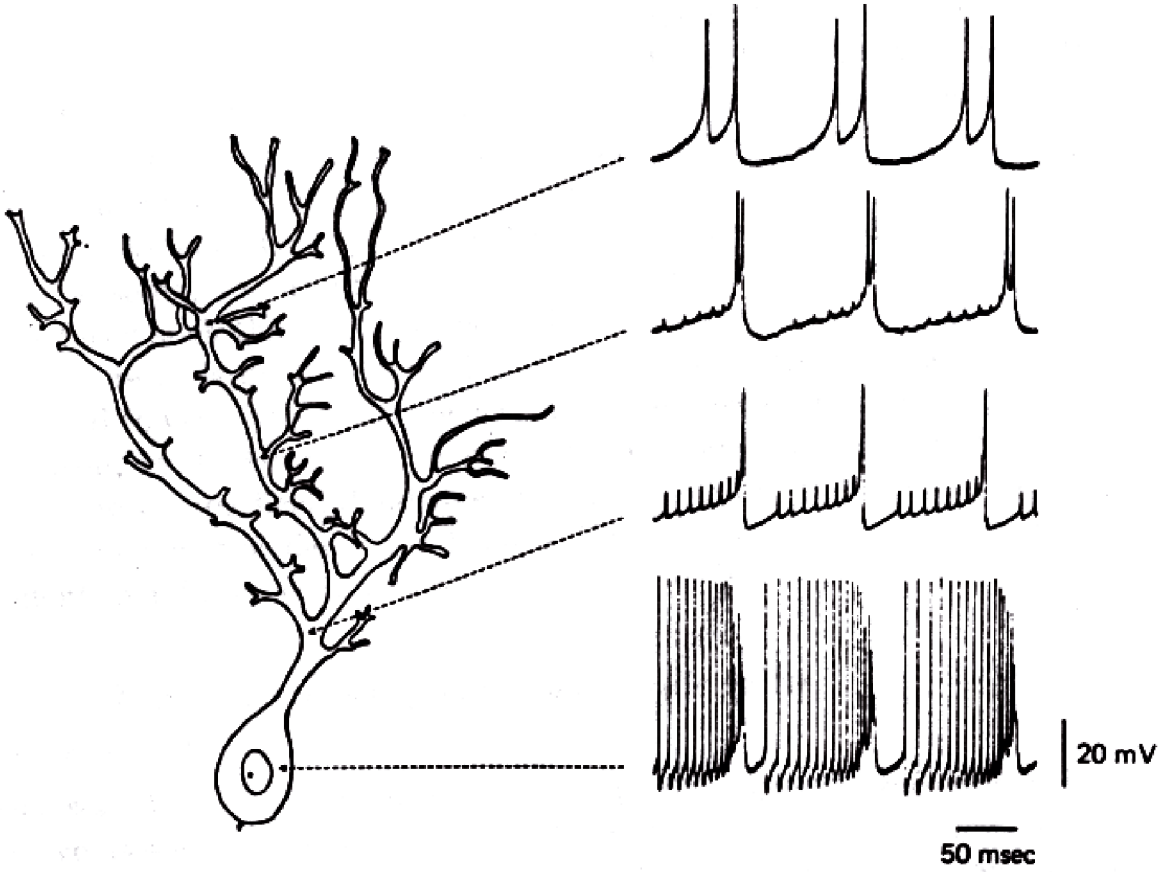

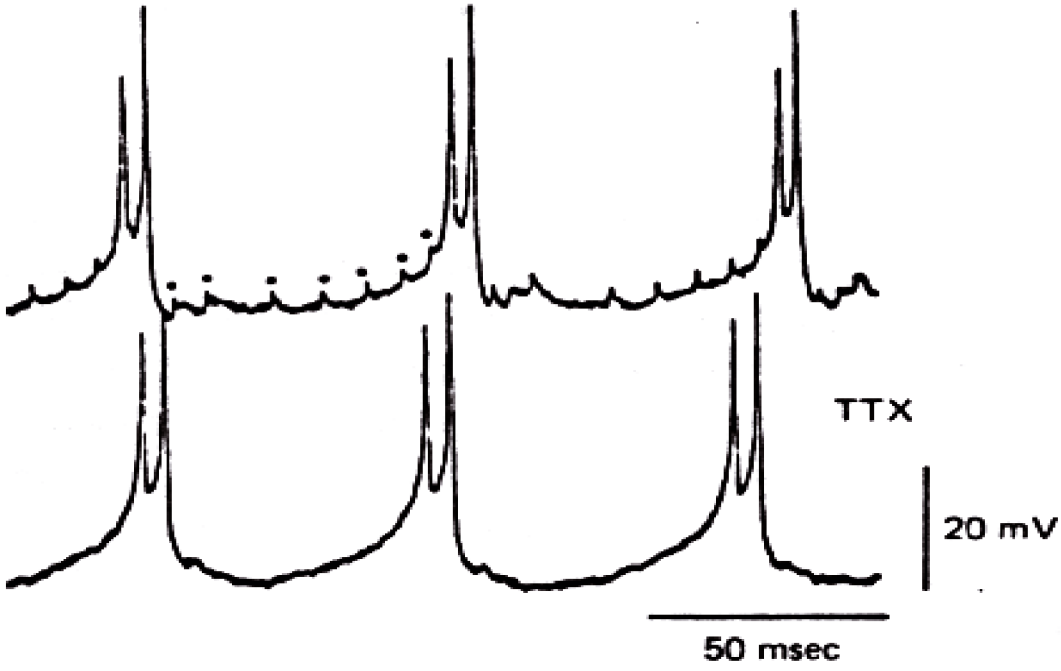

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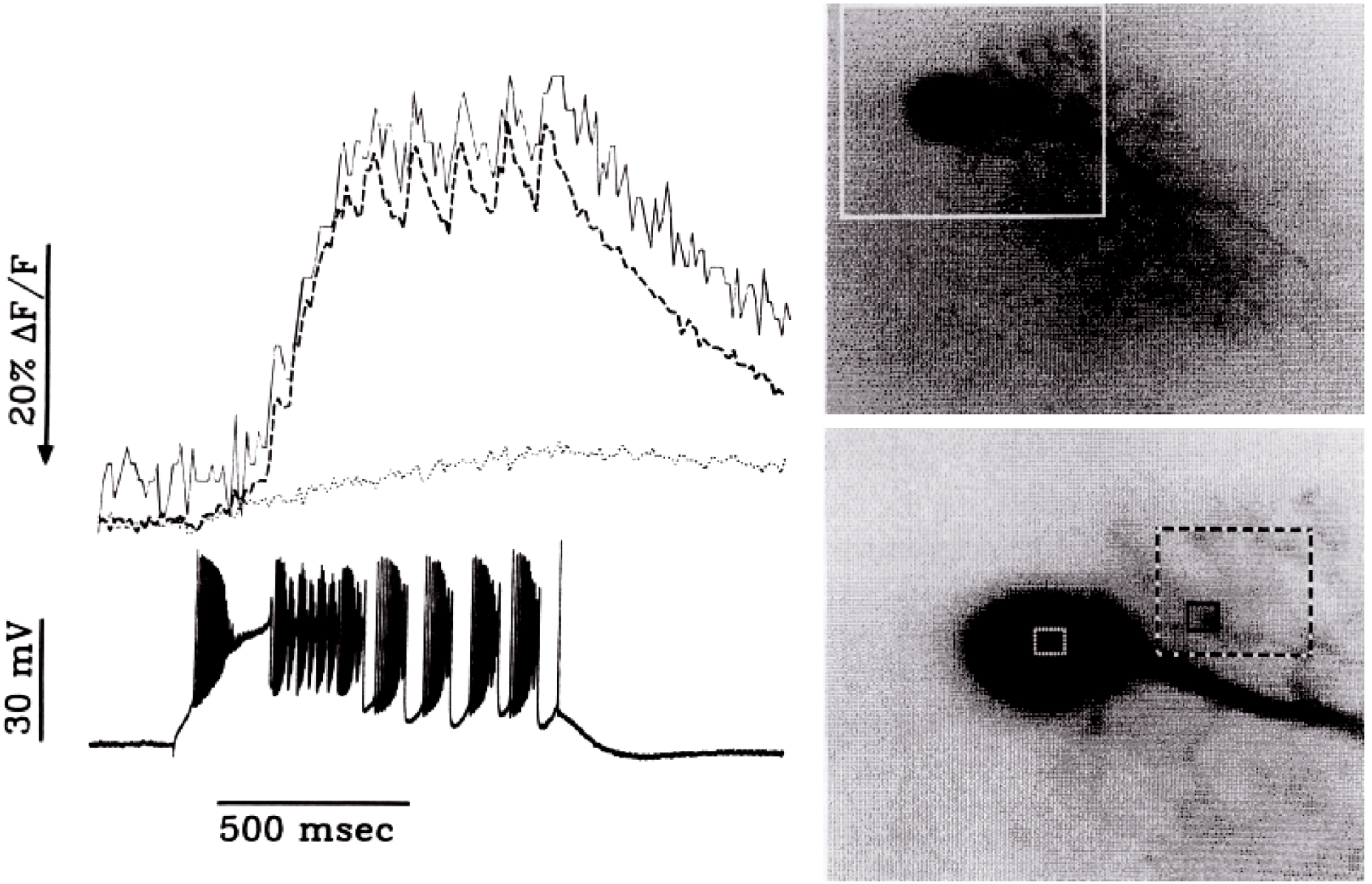

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