Isolation of somatic Na^+ currents by selective inactivation of axonal channels with a voltage prepulse

- Supplemental material -

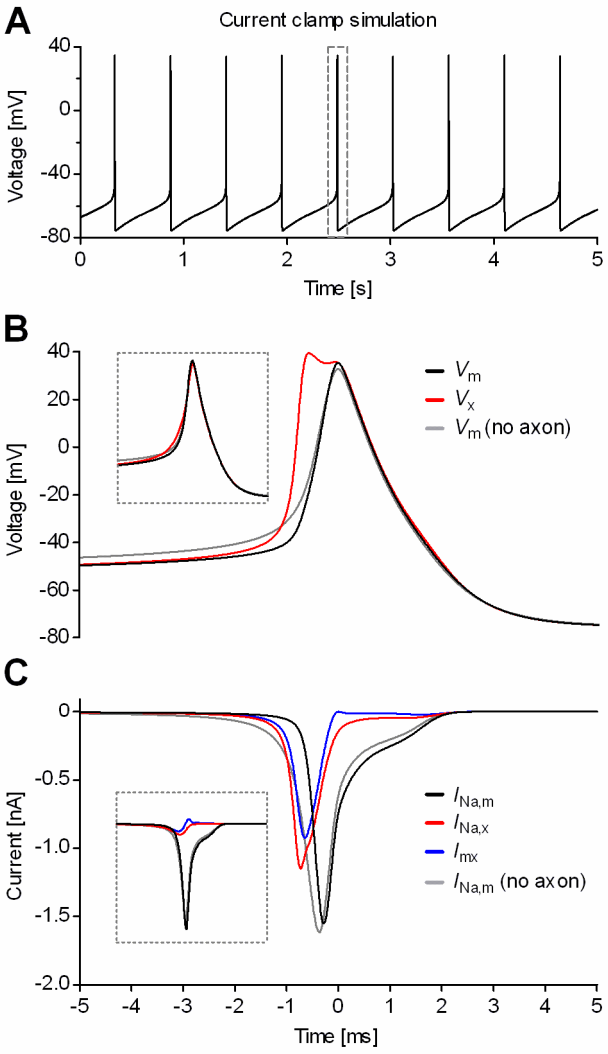
Lorin S. Milescu[1,2], Bruce P. Bean[1], and Jeffrey C. Smith[2]
[1]Department of Neurobiology, Harvard Medical School, Boston, MA.
[2]Cellular and Systems Neurobiology Section, NINDS, NIH, Bethesda, MD.

Parameter	Units	Value	
		Current clamp	Voltage clamp
C_m	pF	15	
C_x	pF	1.5	
V_{Na}	mV	62	29
V_K	mV	-80	
V_{Lk}	mV	-50	
$G_{Na,m}$	nS/pF	8	
$G_{Na,x}$	nS/pF	100	
$G_{K,m}$	nS/pF	1	0
$G_{K,x}$	nS/pF	1	0
$G_{Lk,m}$	nS/pF	0.002	
$G_{Lk,x}$	nS/pF	0.002	
G_{mx}	nS	15	

Supplemental Table 1. Compartmental model parameters. The conductance values for Na_v and K_v channels and for the leak are given as densities. Whenever used in the model, they are multiplied by the values of C_m or C_x.

Parameter	Value
Na_v channel	
$\alpha_{m,0}$	5.254
$\alpha_{m,1}$	0.01474
$\beta_{m,0}$	0.3454
$\beta_{m,1}$	-0.08526
γ_0	85.07
γ_1	0.005784
δ	5.895
δ	-0.01043
γ'_0	25.45
γ'_1	0.005784
δ'_0	26.06
δ'_1	-0.01043
$\alpha_{h,0}$	0.01068
$\alpha_{h,1}$	-0.04270
$\beta_{h,0}$	0.05954
$\beta_{h,1}$	0.02803
$\alpha_{ho,0}$	0.004182
$\alpha_{ho,1}$	-0.04270
$\beta_{ho,0}$	1.805
$\beta_{ho,1}$	0.02803
a	0.71098
b	8.1799
K_v channel	
$\alpha_{n,0}$	0.25
$\alpha_{n,1}$	0.1
$\beta_{n,0}$	5×10^{-5}
$\beta_{n,1}$	-0.1

Supplemental Table 2. Ion channel kinetic parameters. The k_0 parameters (e.g., $\alpha_{m,0}$) are in ms^{-1}, the k_1 parameters (e.g., $\alpha_{m,1}$) are in mV^{-1}, and the a and b parameters are adimensional.



Supplemental Figure 1. Compartmental model dynamics.
A, The compartmental model was tuned to spike spontaneously at ≈2 Hz, similar to raphé neurons. ***B*** & ***C***, A detailed view of one action potential. The axonal voltage V_x rises faster than the somatic voltage V_m, due to the greater density of axonal Na_v channels ($G_{Na,x}$). The difference between V_x and V_m causes depolarizing axial current I_{mx} to flow into the soma, together with somatic Na^+ current $I_{Na,m}$. As a result, the action potential rises more abruptly than in the soma-only case (gray traces). The insets in (***B***) and (***C***) correspond to a simulation where $G_{Na,x} \approx G_{Na,m}$, and the voltage sensitivity of axonal Na_v channels was 10 mV more negative.