Supplementary Table 1: Maximal conductances $\overline{g}$ (mS/cm^2) and permeabilities (cm/s) of the currents included in the model. Transient Na^+ current (I_{NaT}), persistent Na^+ current (I_{NaP}), intermediate Na^+ current ($I_{NaT\text{-}In}$), delayed rectifier K^+ current (I_{KDR}), slow K^+ current (I_{Kslow}), A-type K^+ current (I_{KA}), M-type K^+ current (I_{KM}), Voltage- and Ca^{2+}-dependent K^+ current (I_{KCT}), Ca^{2+}-dependent K^+ current (I_{KAHP}), leak K^+ current (I_{Kleak}), T-type Ca^{2+} current (I_{CaT}), L-type Ca^{2+} current (I_{CaL}), R-type Ca^{2+} current (I_{CaR}), N- and P/Q-type Ca^{2+} current (I_{Canpq}), hyperpolarization activated current (I_H). Since the Ca^{2+} currents were calculated according to the Goldman-Hodgkin-Katz equation the permeabilities are given instead of conductances. The conductance for I_{NaP} was systematically varied (see results). Some current densities at the dendrites were scaled linearly with the distance from soma (gradient, see Supplementary Table 2).

Current	Soma	Dendrites	Axon	Axon hillock	AIS
I_{NaT}	50	gradient	80	50	200
I_{NaP}	varied	-	-	varied	varied
$I_{NaT\text{-}In}$	0.5	-	-	0.5	0.5
I_{KDR}	5	9	25	5	30
I_{Kslow}	12	2		12	8
I_{KA}	11	gradient	20	11	20
I_{KM}	3.2	-	5	3.2	4
I_{KCT}	20	-	-	-	-
I_{KAHP}	0.4	-	-	-	-
I_{Kleak}	0.04	0.04	-	-	-
I_{CaT}	$1\ 10^{-5}$	gradient	-	-	-
I_{CaL}	$6.622\ 10^{-5}$	-	-	-	-
I_{CaR}	$4.4\ 10^{-5}$	-	-	-	-
I_{Canpq}	$1.54\ 10^{-5}$	-	-	-	-
I_H	0.005	0.01	-	-	-

Supplementary Table 2: Somatodendritic gradients of maximal conductances in apical and basal dendrites for I_{CaT}, I_{KA} and I_{NaT}. Conductances/permeabilities along the dendrites were calculated as f(x)=ax+b with x defined as distance from the soma normalized to the length of the dendrite (x=0 to x=1 from the nearest to the most distant point from the soma, respectively).

Apical dendrites	a	b
I_{CaT}	$3\ 10^{-5}$	$6\ 10^{-6}$
I_{KA}	30	20
I_{NaT}	-5	10
Basal dendrites		
I_{CaT}	$1.2\ 10^{-5}$	$6\ 10^{-6}$
I_{KA}	20	20
I_{NaT}	-5	10

Supplementary Table 3: Parameters of single action potentials in *Scn1b* and *Scn2b* null mice and their littermate controls.

		Scn1b		*Scn2b*	
		+/+	-/-	+/+	-/-
Action potential morphology	Peak (mV)	29±2.0	17±3.6	19±2.0	19±2.9
	Slope (mV/ms)	514±48	406±62	374±7	357±62
	Threshold (mV)	-54±2.8	-56±3.1	-53±3.1	-51±4.4
	Halfwidth (ms)	0.68±0.05	0.86±0.06	0.72±0.04	0.71±0.02

Supplementary Figure 1: Acceleration of inactivation with CBZ. Time course of decay was quantified with monoexponential fitting at various command potentials for *Scn1b* and *Scn2b* null mice (panel A_3, A_4) and their littermate controls (panels A_1, A_2). Significant differences are indicated by asterisks.