The role of local dendritic depolarization on the propagation of APs to basal dendrites.

To test whether propagation of BAPs to basal dendrites can be modulated by local dendritic depolarization we performed experiments using direct current injection at the dendritic electrode (Supplementary Fig. 1a-d). We found no significant boosting or attenuation with current injection causing membrane potential deflections of ±12 mV (n=4). We do not rule out the possibility that boosting effects can occur in the distal region of the dendrite.

Our experimental data are consistent with additional NEURON simulations in which we modeled the interaction of coincident BAPs and EPSPs in basal dendrites (Supplementary Fig. 1f, 100 µm from soma). As control we performed similar simulations for apical dendrites as described by Stuart and Häusser (2001) (Supplementary Fig. 1e, 500 µm from soma). The basal location was selected so that the BAP had the same amplitude as a BAP at the corresponding apical site. Coincident occurrence of an apical EPSP and a BAP resulted in a substantial boosting of the BAP amplitude as described previously (Stuart and Häusser, 2001). Surprisingly, in basal dendrites, this coincidence did not lead to a substantial boosting of BAP amplitude for all EPSP intensities and all distances tested (1-30 mV, 20-300 µm). The lack of apparent boosting in basal dendrites might be the result of subthreshold propagation to basal dendrites. Subthreshold voltages do not propagate to apical dendrites as well as to basal dendrites. As local depolarization is a key component in the boosting process, in apical dendrites the extra depolarization would cause boosting while in the case of basal dendrites the local dendrite would be already ‘saturated’ by the somatic voltage prior to the action potential, and further dendritic depolarization in the form of an EPSP would be ineffective.

Supplementary Figure 1 The effect of dendritic depolarization on BAP propagation to basal dendrites. a, Experimental setting showing a two-photon fluorescence image of a layer 5 pyramidal neuron with a double recording at the soma (blue) and basal dendrite (red, 60 µm from the soma). b, Somatic (blue) and dendritic (red) voltage recordings of a somatically evoked AP paired with dendritic current injections (100 ms, -300 to +400 pA). c, Dendritic recordings shown in (b) on an expanded time scale (note: at more depolarized potentials 2 APs were generated at the soma). d, Averaged and normalized dendritic AP amplitudes for different dendritic current injections. AP amplitudes were normalized to the AP amplitudes with no dendritic current injection (n=4). e-f, Computer simulations showing the effect on the amplitude of the BAP when paired with a coincident EPSP (time interval between peak of dendritic EPSP and peak of somatic AP of 0 ms) in the dendrite (red) and soma (blue). The comparison is show for a BAP in the apical dendrite (e) and a basal dendrite (f). e, In the apical dendrite (500 µm from soma; ~50% apical dendritic length), BAPs are boosted substantially by pairing with coincident EPSPs. f, In basal dendrites (100 µm from soma; ~50% basal dendritic length) pairing EPSPs has a negligible effect on the amplitude of the BAP. In the example shown, the basal location was selected so that the BAP will be of the same amplitude as in the apical site. The result was the same for all EPSP intensities and all basal dendritic distances tested (1-30 mV, 20-300 µm).