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The cost of linearization DANIELLE MOREL, WILLIAM B LEVY, University of Virginia — Information processing in the brain is metabolically expensive and energy usage by the different components of the nervous system is not well understood. In a continuing effort to explore the costs and constraints of information processing at the single neuron level, dendritic processes are being studied. More specifically, the role of various ion channel conductances is explored in terms of integrating dendritic excitatory synaptic input. Biophysical simulations of dendritic behavior show that the complexity of voltage-dependent, non-linear dendritic conductances can produce simplicity in the form of linear synaptic integration. Over increasing levels of synaptic activity, it is shown that two types of voltage-dependent conductances produce linearization over a limited range. This range is determined by the parameters defining the ion channel and the 'passive' properties of the dendrite. A persistent sodium and a transient A-type potassium channel were considered at steady-state transmembrane potentials in the vicinity of and hyperpolarized to the threshold for action potential initiation. The persistent sodium is seen to amplify and linearize the synaptic input over a short range of low synaptic activity. In contrast, the A-type potassium channel has a broader linearization range but tends to operate at higher levels of synaptic bombardment. Given equivalent 'passive' dendritic properties, the persistent sodium is found to be less costly than the A-type potassium in linearizing synaptic input.

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