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**Title:** Effects of different types of spike frequency adaptation on spike timing and rate coding  
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Spike frequency adaptation refers to the reduction of spiking during prolonged stimulation and is typically ascribed to one of two  $K^+$  currents: The voltage-activated M-type  $K^+$  current ( $I_M$ ) or the calcium-activated  $K^+$  current ( $I_{AHP}$ ). Using a Morris-Lecar model and bifurcation analysis, we illustrate how the distinct activation properties of  $I_M$  and  $I_{AHP}$  impact modulation of spiking. Because activation of  $I_M$  is sustained at subthreshold voltages,  $I_M$  tends to stop the neuron from spiking after a delay proportional to stimulus intensity. In contrast, activation of  $I_{AHP}$  is pulsatile, rapidly increasing with each spike but waning between spikes so that spiking is slowed but not stopped. Consequently, effects of  $I_M$  and  $I_{AHP}$  on a neuron's steady-state frequency-current ( $f-I$ ) curve are fundamentally different:  $I_M$  modulates offset whereas  $I_{AHP}$  modulates gain. Moreover,  $I_M$  can convert neuronal excitability from type 1 to type 2, whereas  $I_{AHP}$  does the opposite. Other effects of adaptation are also context-dependent, i.e. vary depending on the intrinsic excitability of the neuron. Because of these differences, the impact of each adaptation mechanism on neural coding is distinct:  $I_M$  improves time coding of stimulus fluctuations whereas  $I_{AHP}$  improves rate coding of time-averaged stimulus intensity - in that regard,  $I_M$  and  $I_{AHP}$  encourage the neuron to behave as either a coincidence detector or integrator, respectively. Thus, spiking is modulated in very different (potentially opposite) ways depending on the biophysical mechanism underlying adaptation and the context in which that adaptation occurs, which in turn has important consequences for neuronal coding properties. Spike frequency adaptation is therefore not a generic process; on the contrary, predicting the effects of adaptation requires identification of the underlying mechanism.

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