Computational model of a single oxytocin neuron. Spiking, secretion and plasma oxytocin dynamics.

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About 9000 magnocellular oxytocin neurones are located in the rat hypothalamus. They project their axons to the posterior pituitary where they secrete oxytocin into the bloodstream.

**SPIKING MODEL** mimics electrophysiological data of oxytocin cells responding to cholecystokinin (CCK), a peptide produced in the gut after food intake.

**SECRETION MODEL** mimics the non-linearity between secretion and spiking activity.

**DIFFUSION MODEL** mimics the plasma clearance of oxytocin, replicating the dynamics found after infusion and injection of oxytocin.

Every oxytocin neuron receives hundreds of input signals that produce postsynaptic potentials (PSPs). Excitatory PSPs depolarize its membrane potential (Vm), and inhibitory PSPs hyperpolarize it. The model assumes that these arrive randomly at some given rate.

The sum of PSPs (Vm) is added to the membrane resting potential (Vrest). When Vm reaches Vthreshold, a spike is produced and the neuron produces a HAP (hyperpolarising afterpotential) and an AHP (after-hyperpolarisation) (6).

**Role of AHP combined with the frequency facilitation in secretion.** Large diamonds represent the secretion response to mean firing rates of 1, 4 and 7 spikes/s. Dot clouds represent the secretion response during 1000 s when the modelled neuron receives random PSPs that produce average firing rates of 1 (green crosses), 4 (blue circles) and 7 spikes/s (red phases).