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A generic model for selective adaptation in networks of heterogeneous populations

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Adaptation is a biologically ubiquitous process whereby features of the system's responsiveness change as a result of persistent input. Most often, the kinetics of the change are monotonic and depend upon the input frequency. Adaptation in neural systems is inherently selective to the input characteristics; not only between sensory modalities, but even within a given modality, the system is capable of reducing its sensitivity to frequent input while preserving (or even enhancing) its sensitivity to the rare (e.g. [1-4]). *In-vivo* analyses suggest that a within-modality selective adaptation does not require concrete, precise point-to-point wiring (which would be a trivial yet non-physiological realization) [5]. Indeed, theoretical considerations indicate that, for the case of a single neuron, selective adaptation can be explained in terms of synaptic population dynamics (e.g. [6]). *In-vitro* analyses in networks of cortical neurons show that, beyond temporal dynamics, differences between topologies of excitatory and inhibitory sub-networks account for the full range of selective adaptation phenomena, including increased sensitivity to the rare [7]. Formal descriptions of selective adaptation are hindered by the problem of representing these different topologies in an analytically useful manner. In this study we offer a formalism that expresses topologies of connectivity in terms of temporal input gain modulation. Using this technique, we are able to formulate a generic analytic model for selective adaptation, which reconstructs all the major experimentally observed phenomena, offers predictions for further experimental analyses, and caters for a rigorous characterization of adaptation in general, and selective adaptation in particular.

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