

Abstract Submitted
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Increased Accuracy of Ligand Sensing by Receptor Internalization and Lateral Receptor Diffusion GERARDO AQUINO, ROBERT ENDRES, Imperial College London — Many types of cells can sense external ligand concentrations with cell-surface receptors at extremely high accuracy. Interestingly, ligand-bound receptors are often internalized, a process also known as receptor-mediated endocytosis. While internalization is involved in a vast number of important functions for the life of a cell, it was recently also suggested to increase the accuracy of sensing ligand as overcounting of the same ligand molecules is reduced. A similar role may be played by receptor diffusion on the cell membrane. Fast, lateral receptor diffusion is known to be relevant in neurotransmission initiated by release of neurotransmitter glutamate in the synaptic cleft between neurons. By binding ligand and removal by diffusion from the region of release of the neurotransmitter, diffusing receptors can be reasonably expected to reduce the local overcounting of the same ligand molecules in the region of signaling. By extending simple ligand-receptor models to out-of-equilibrium thermodynamics, we show that both receptor internalization and lateral diffusion increase the accuracy with which cells can measure ligand concentrations in the external environment. We confirm this with our model and give quantitative predictions for experimental parameters values. We give quantitative predictions, which compare favorably to experimental data of real receptors.

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