# Benefits of diversity: from molecular organization to cell signaling

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Cellular signaling is regulated by biochemical interactions that are ultimately controlled by molecular diffusion. Recent advances in fluorescence microscopy have allowed the visualization of single molecules in living cells at unprecedented spatiotemporal resolution, revealing that the heterogeneity of the cellular environment produces exotic molecular motions that deviate from Brownian behavior [1]. These findings have stimulated new questions about the mechanisms generating these phenomena, as well as regarding their implications for cell biology.
In this context, we have studied a transmembrane receptor involved in the capture of pathogens, which motion exhibits anomalous diffusion with signatures of weak ergodicity breaking [2]. Through the study of receptor mutants, we have been able to correlate the receptors motion to its molecular structures, lateral organization and interactions, thus establishing a link between nonergodicity and biological function.
In addition, we have quantitatively interpreted the receptor dynamics through a stochastic model of random motion with random diffusivity on scale-free media [3,4], and we are attempting to gain further insight into the molecular causes of this complex diffusion.
Our work highlights the role of heterogeneity in cell membranes and proposes a connection with function regulation. In addition, our models offer a theoretical framework to interpret anomalous transport in complex media, such as those found, e.g., in soft condensed matter, geology, and ecology.

References
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