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Precision of sensing, memory and fluctuating environments GERARDO AQUINO, ROBERT ENDRES, Division of Molecular Biosciences & Centre for Integrated Systems Biology at Imperial College, Imperial College London — Multiple cell types were recently shown to sense their chemical environment with astonishing accuracy, crucial for nutrient scavenging, mating, immune response, and development. It is currently unknown if this sensing near the single-molecule detection limit is due to highly precise single measurements, or due to learning over time. In this work, we analyze if cell memory can allow cells to sense beyond the current estimates of the fundamental physical limit. By merging Bayesian inference with information theoretic concepts, we derive analytical formulas which show that memory improves sensing in correlated fluctuating environments, but not in strongly uncorrelated environments. Despite many analogies with problem solving strategies in engineering, our theory shows fundamental differences in interpreting noisy stimuli in the microscopic and macroscopic world.

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