Robustness of signalling in bacterial chemotaxis

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BACTERIAL chemotaxis has been extensively used as a relatively simple model system of environmental signal processing, to gain general insights into properties of biological networks. One of such properties is robustness, and we propose that many features of the chemotaxis pathway can be explained by the evolutionary selection for robust signal processing under perturbing conditions. Chemotactic performance of bacteria is affected by several types of perturbations or noise, from stochastic ligand binding to Brownian motion to stochastic protein expression. We investigated effects of the most prominent type of noise, stochastic variations in the levels of chemotaxis proteins in a population, and showed that such gene expression noise is compensated both by the robust pathway topology and by the chromosomal organization of chemotaxis genes. We also studied robustness of chemotaxis against another common type of perturbation, variations in ambient temperature, and show that the pathway evolved to compensate such variations at multiple levels.