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Precise Adaptation in Bacterial Chemotaxis through "Assistance Neighborhoods"[1]

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The chemotaxis network in *Escherichia coli* is remarkable for its sensitivity to small relative changes in the concentrations of multiple chemical signals over a broad range of ambient concentrations. Key to this sensitivity is an adaptation system that relies on methylation and demethylation (or deamidation) of specific modification sites of the chemoreceptors by the enzymes CheR and CheB, respectively. It was recently discovered that these enzymes can access five to seven receptors when tethered to a particular receptor. We show that these "assistance neighborhoods" (ANs) are necessary for precise and robust adaptation in a model for signaling by clusters of chemoreceptors: (1) ANs suppress fluctuations of the receptor methylation level; (2) ANs lead to robustness with respect to biochemical parameters. We predict two limits of precise adaptation at large attractant concentrations: either receptors reach full methylation and turn off, or receptors become saturated and cease to respond to attractant but retain their adapted activity.

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