Networked Chemoreceptors Benefit Bacterial Chemotaxis Performance

Chemoreceptor arrays are found in many motile bacteria. In *E. coli* these extended arrays are composed of networked signaling complexes, and promote cooperative stimulus control of their associated signaling kinases. Although our understanding of bacterial chemotaxis is quite detailed, the signaling and behavioral advantages of networked receptor arrays had not been directly studied in cells. We used structural lesions at the interface between core signaling complexes to create an *E. coli* strain with functional but dispersed signaling complexes. This strain allowed us to directly study how networking of signaling complexes affects chemotactic signaling and gradient-tracking performance. We directly demonstrate that networking of receptor complexes provide wild type cells with about 10-fold heightened sensitivity to attractant while maintaining a wide dynamic range over which receptor modifications can modulate their response sensitivity. We further show that adaptation of receptors in dispersed signaling complexes is slower than it is in extended arrays, which could be compensated by overexpression of the adaptation enzymes. Finally, we found that networking of receptor complexes is generally advantageous for chemotaxis under various conditions, and especially critical for chemotaxis towards a non-metabolizable attractant source. The later, mimics natural conditions in which bacteria are too sparse to significantly alter the attractant distribution.