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Crosstalk Regulates the Capacity for Robust Collective Decision Making in Heterogeneous Microbial Communities TAHIR YUSUFALY, JAMES BOEDICKER, Univ of Southern California — Microbial communities frequently communicate via quorum sensing (QS), where cells produce, secrete, and respond to a threshold level of an autoinducer (AI) molecule, thereby modulating density-dependent gene expression. However, the biology of QS remains incompletely understood in heterogeneous communities, where crosstalk between distinct QS systems leads to novel effects. Such knowledge is necessary both for understanding signaling in real microbial communities, and for the rational design of synthetic communities with designer properties. As a step towards this goal, we investigate the effects of crosstalk between Gram-negative bacteria communicating via LuxI/LuxR-type QS systems, with acyl-homoserine lactone (AHL) AI molecules. After mapping QS in a heterogeneous community onto an artificial neural network model, we systematically analyze how heterogeneity regulates the community's capability for stable yet flexible decision making. We find that there are preferred distributions of interactions which provide optimal tradeoffs between capacity, or the number of different decisions a population can make, and robustness, or the tolerance of the community to disturbances. We compare our results to inferences made from experimental data, and critically discuss implications for the biological significance of crosstalk.

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