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Bacterial tower of Babel –How cheating and lying diversify bacterial communication

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In microbial "quorum sensing" (QS) communication systems, microbes produce and respond to a signaling molecule, enabling a cooperative response at high cell densities. Many species of bacteria show fast, intraspecific, evolutionary divergence of their QS pathway specificity—signaling molecules activate cognate receptors in the same strain but fail to activate, and sometimes inhibit, those of other strains. Despite many molecular studies, it has remained unclear how a signaling molecule and receptor can coevolve, what maintains diversity, and what drives the evolution of cross-inhibition. Here I use mathematical analysis to show that when QS controls the production of extracellular enzymes —"public goods"—diversification can readily evolve. Coevolution is positively selected by cycles of alternating "cheating" receptor mutations and "cheating immunity" signaling mutations. The maintenance of diversity and the evolution of cross-inhibition between strains are facilitated by facultative cheating between the competing strains. My results suggest a role for complex social strategies in the long-term evolution of QS systems. More generally, my model of QS divergence suggests a form of kin recognition where different kin types coexist in unstructured populations.