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Modeling the role of quorum sensing in interspecies competition in biofilms AVANEESH V. NARLA, Department of Physics, Princeton University, Princeton, NJ 08544;, NED S. WINGREEN[1], Department of Molecular Biology, Princeton University, Princeton, NJ 08544;, DAVID B. BORENSTEIN, Lead Data Scientist, Charity Navigator, 139 Harristown Rd #101, Glen Rock, NJ 07452 — Bacteria grow on surfaces in complex immobile communities known as biofilms, composed of cells embedded in an extracellular matrix. Within biofilms, bacteria often communicate, cooperate, and compete within their own species and with other species using Quorum Sensing (QS). QS refers to the process by which bacteria produce, secrete, and subsequently detect small molecules called autoinducers as a way to assess the local population density of their species, or of other species. QS is known to regulate the production of extracellular matrix. We investigated the possible benefit of QS in regulating matrix production to best gain access to a nutrient that diffuses from a source positioned away from the surface on which the biofilm grows. We employed Agent-Based Modeling (ABM), a form of simulation that allows cells to modify their behavior based on local inputs, e.g. nutrient and QS concentrations. We first determined the optimal fixed strategies (that do not use QS) for pairwise competitions, and then demonstrated that simple QS-based strategies can be superior to any fixed strategy. In nature, species can compete by sensing and/or interfering with each other's QS signals, and we explore approaches for targeting specific species via QS-interference.

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