

Greed and altruism: how quorum sensing mediates between these two behaviors

Eleonora Alfinito,¹ Matteo Beccaria^{1,2,3}

¹Dipartimento di Matematica e Fisica 'Ennio De Giorgi' -Università del Salento, via Arnesano, 73100, Lecce, Italy

²Istituto Nazionale di Fisica Nucleare - sezione di Lecce, Via Arnesano, I-73100 Lecce, Italy

³National Biodiversity Future Center, Palermo 90133, Italy.

eleonora.alfinito@unisalento.it

matteo.beccaria@unisalento.it

Greed and altruism are two sides of the same coin, and represent opposite antagonistic mechanisms that may lead communities of social beings to extinction. Bacterial strains consisting of unconditional cooperators (UC) or defectors (DC) in relation to the production of public goods, have been analyzed under different experimental conditions¹ and both die out quickly. UC are characterized by a low growth efficiency and become extinct due to aging even in presence of leftover resources. DC are greedy, grow fast, and rapidly run out of food. On the other hand, well-mixed UC and DC populations survive longer. Quorum sensing (QS)² is the ability of bacteria to cooperate when a density threshold is reached, and was proposed as the *deus-ex-machina* that presides over this phenomenon¹. In previous works^{3,4} we proposed a model describing the bacterial colony formation and its related bioluminescence. In this description, both phenomena are mediated by a long-range interaction which implements QS (QSa).

Here, modeling is improved to account for the presence of two different types of cooperators. By appropriately modifying the parameters of the model, it is possible to reproduce UC or DC behavior.

We analyze by numerical simulations the evolution of a mixed state of both these strains and examine the role of QSa in its stability over time. We show that it effectively acts as a regulator by mediating resource distribution based on UC, DC densities with the effect of increasing the typical survival time compared to that of pure states.

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