STRATEGIES USED BY COOPERATORS TO CURB THE CHEATER POPULATION IN A BACTERIAL COMMUNITY

Spatial structuring and kin selection

As cooperators build biofilms, they keep their kin close and limit cheaters’ access to communal resources.

KIN DISCRIMINATION

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POLICING

Cooperating bacteria can sanction cheaters by producing diffusible toxins together with a resource.

Cooperator

Cheater

Public good

Toxin

Immunity factor

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—Megan Frederickson, University of Toronto

Discriminating kin from non-kin also enables cooperators to directly sanction cheaters by policing them. To police communities, cooperators may produce an energetically costly compound, often a toxin, to control the number of cheaters within the group. For instance, P. aeruginosa produces a shareable protease along with a toxin, cyanide. Cooperators produce an immunity factor that protects them from the cyanide, thus selectively killing cheaters.3

As social creatures, bacteria perform a variety of collective behaviors that enable them to thrive in different environments. Like other social animals, they must also deal with individuals that do not cooperate but still want to take a share of the goods produced by others. Although cheaters threaten bacterial cooperation, they do not undermine it as both cooperators and natural selection weigh in to control their spread. “The interest in the social lives of microbes is because they make a good experimental system for our larger ideas about how cooperation works, including in animals or in plants,” Frederickson said.

Additionally, a better understanding of the social dynamics of bacteria might help us either come up with new therapies or offer ideas that we could use for biological control, added Frederickson. “We think of [bacteria] as simple organisms, but they are not. They have been evolving on this planet for a very, very long time. And they are capable of some very sophisticated things. I think we don’t give them quite enough credit.”

References