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Physical solutions to the public goods dilemma in bacterial biofilms KNUT DRESCHER, CAREY NADELL, HOWARD STONE, NED WINGREEN, BONNIE BASSLER, Princeton University — Bacteria frequently live in densely populated surface-bound communities, termed biofilms. Biofilm-dwelling cells rely on secretion of extracellular substances to construct their communities and to capture nutrients from the environment. Some secreted factors behave as cooperative public goods: they can be exploited by non-producing cells. The means by which public good producing bacteria avert exploitation in biofilm environments are largely unknown. Using experiments with *Vibrio cholerae*, which secretes extracellular enzymes to digest its primary food source, the solid polymer chitin, we show that the public goods dilemma may be solved by two dramatically different, physical mechanisms: cells can produce thick biofilms that confine the goods to producers, or fluid flow can remove soluble products of chitin digestion, denying access to non-producers. Both processes limit the distance over which enzyme-secreting cells provide a benefit to neighbors, resulting in preferential benefit to nearby clonemates. Our results demonstrate how bacterial physiology and environmental conditions can interact with social phenotypes to influence the evolutionary dynamics of cooperation within biofilms.

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