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Cooperation controls partners spatial intermixing in a synthetic bacterial consortium

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Background
In the environment, microorganisms interact and function within multispecies communities usually showing high degree of spatial organization. However, high complexity and diversity in natural microbial systems hamper mechanistic understanding of what controls spatial assembly and activity of microbes.

Objectives
We aim to reveal basic principles governing microbial spatial organization on surfaces. Here, we examine how changes in trophic interaction (cooperation vs. competition) and in partners ratio shape the assembly of a model two-member bacterial consortium.

Model: consortium degrading toluene
Pseudomonas putida strains F4 and F107 are two mutants derived from wild-type F1, a toluene degrader. Unlike F1, the mutants have to cooperate as a consortium to fully degrade toluene and use it as carbon source for growth.

Growth on toluene vapor leads to convergent partners ratios in liquid cultures
Strains are grown in mineral medium with toluene as sole carbon source

Initial partners ratio affects growth on surfaces

Conclusions & Outlook
Defined trophic dependencies can impose stable bacterial organization patterns on surfaces. In particular, cooperation promote intermixing, while competition segregates bacterial populations.
Identifying simple rules for bacterial spatial organization paves the way for improved prediction and control of bacterial activity in natural as well as industrial environments.