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Multiscale Characterization of Bacterial Swarming Illuminates Principles Governing Directed Surface Motility BEN STRICKLAND, KENTARO HOEGER, TRISTAN URSELL, University of Oregon — In many systems, individual characteristics interact, leading to the spontaneous emergence of order and complexity. In biological settings like microbes, such collective behaviors can imbue a variety of benefits to constituent individuals, including increased spatial range, improved access to nutrients, and enhanced resistance to antibiotic threats. To untangle the biophysical underpinnings of collective motility, we use passive tracers and a curated genetic library of *Bacillus subtilis*, including motile, non-motile, biofilm-deficient, and non-chemotactic mutants. We characterize and connect individual behavior on the microscopic scale to macroscopic colony morphology and motility of dendritic swarming. We analyze the persistence and dynamics of coordinated movement on length scales up to 4 orders of magnitude larger than that of individual cells, revealing rapid and directed responses of microbial groups to external stimuli, such as avoidance dynamics across chemical gradients. Our observations uncover the biophysical interplay between individual motility, surface wetness, phenotypic diversity, and external physical forces that robustly precipitate coordinated group behavior in microbes, and suggest general principles that govern the transition from individual to group behavior.

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