How moving slower allows groups of bacteria to spread across surfaces

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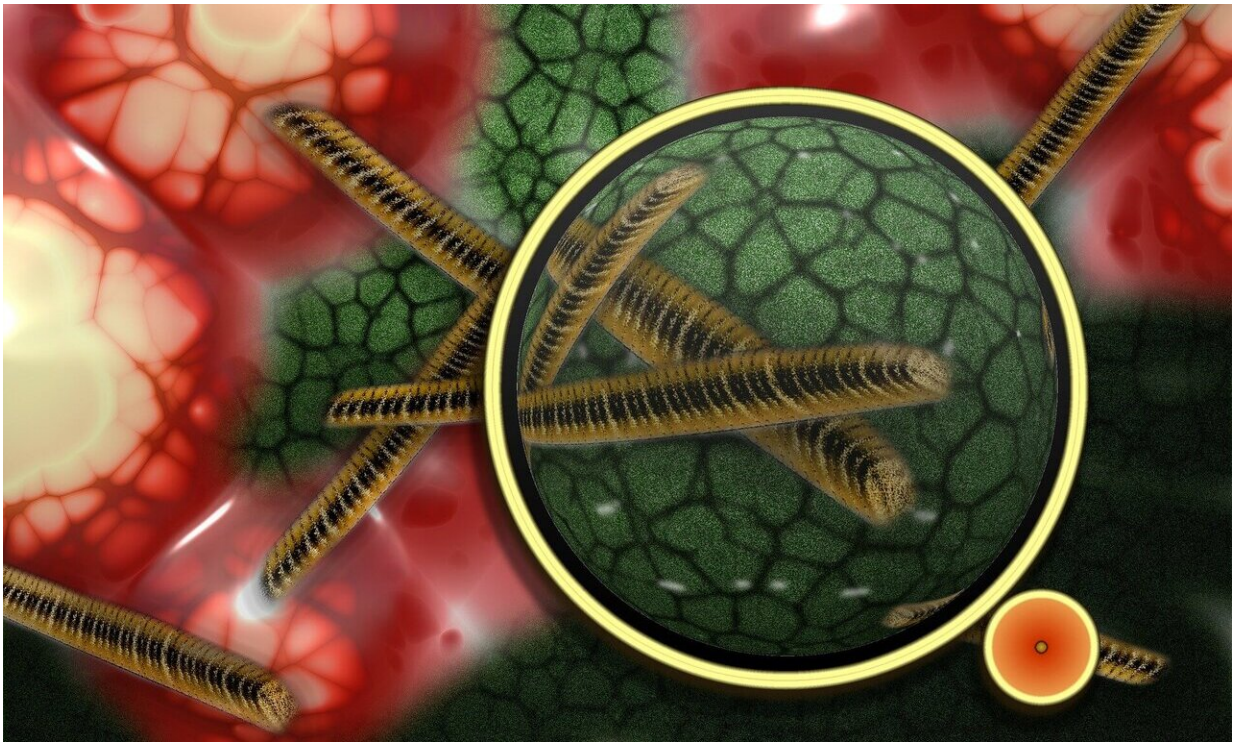

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Scientists have found that bacterial groups spread more rapidly over surfaces when the individuals inside them move slowly, a discovery that may shed light on how bacteria spread within the body during infections.

Researchers from the University of Sheffield and the University of

Oxford studied Pseudomonas aeruginosa, a species of bacteria responsible for deadly lung infections, which moves across surfaces using tiny grappling hook-like appendages called pili. Similar to the fable of the tortoise and the hare, they found that bacteria engineered to individually move faster actually lost the race against slower strains when moving in densely packed groups.

Using a combination of genetics, mathematics, and sophisticated tracking algorithms that can simultaneously follow the movement of tens of thousands of cells, the researchers demonstrated that collisions between the fast-moving bacteria cause them to rotate vertically and get stuck.

In contrast, slower-moving cells remain lying down, allowing them to keep moving. The slower-moving cells therefore win the race into new territory, acquire more nutrients, and ultimately outcompete the faster moving cells. This research suggests that bacteria have evolved slow, restrained movement to benefit the group as a whole, rather than individual cells.

The findings have been published in the journal *Nature Physics*.

Dr. William Durham, a Lecturer in Biological Physics at the University of Sheffield, said: "We routinely experience gridlock in our own lives while traveling by foot or in cars. These traffic jams often occur because individuals have prioritized their own movement over that of their neighbors. In contrast, bacteria have evolved to move carefully and effectively in crowds, likely because their neighbors tend to be genetically identical, so there is no conflict of interest. Bacteria accomplish this by moving more slowly than their top speed."

To understand these phenomena, the researchers used a theory that was originally developed to study materials known as liquid crystals.

Dr. Oliver Meacock, a postdoctoral researcher at the University of Sheffield and lead author of the study, said: "Liquid crystals are everywhere around us, from smartphone screens to mood rings. Although we initially didn't expect that the mathematical tools developed to understand these man-made materials could be applied to living systems, our findings show that they can also shed light on the challenges faced by microbes."

Patterns of collective movement that occur in flocks of birds and schools of fish have long been a source of fascination to onlookers. This new research shows that similarly spectacular forms of collective movement also occur in the microscopic world.

More information: Bacteria solve the problem of crowding by moving slowly, *Nature Physics* (2020). DOI: 10.1038/s41567-020-01070-6 , www.nature.com/articles/s41567-020-01070-6

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