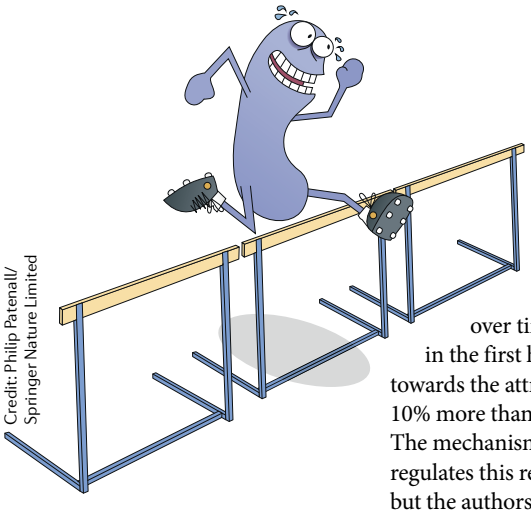

Credit: Philip Patenall/ Springer Nature Limited

release an attractant themselves only when they move up the attractant gradient and when they decrease their tumbling frequency as they encounter more obstacles. Single-cell tracking in the microfluidic chambers confirmed this latter model change; the bacteria indeed tumbled less in the presence of obstacles. Cells in microchambers with obstacles covering 64% of the area tumbled 30% fewer times than cells in microchambers without obstacles. The authors therefore concluded that the bacteria adapted their behaviour and 'learned' how best to perform according to the obstacles that they had encountered in their environment. Supporting this claim, the authors observed that when faced with obstacles, the tumble rate decreased over time. Specifically, in the first half of their swim towards the attractant, cells tumbled 10% more than in the second half. The mechanism of how *E. coli* regulates this response is unclear, but the authors speculate that mechanosensing might be involved.

In conclusion, this study shows that *E. coli* maintains efficient chemotaxis in the presence of obstacles by reducing its tumbling frequency. Natural environments such as the mammalian gut likely contain many obstacles, and guaranteeing efficient chemotaxis towards nutrients despite obstacles would be beneficial.

Ursula Hofer

ORIGINAL ARTICLE Rashid, S. et al. Adjustment in tumbling rates improves bacterial chemotaxis on obstacle-laden terrains. *Proc. Natl Acad. Sci. USA* https://doi.org/10.1073/pnas.1816315116 (2019)

home dust microbiota exhibited high bacterial richness and the presence of cattle-associated microorganisms, rumen-associated archaea and taxa within the Actinomycetales, whereas non-farm rural homes were characterized by higher proportions of human-associated bacteria, including members of the Streptococcaceae family and *Staphylococcus* genus.

They went on to develop models for the farm home microbiota, and the models were applied to data obtained from mostly suburban homes. The results showed that the risk of developing asthma decreases in children who grow up in non-farm homes that exhibit a bacterial microbiota composition that is similar to that of farm homes. Moreover, the association between the farm-like microbiota and asthma risk was similar between children living on farms and those who were not. The asthma-protective effect of the farm-like microbiota was confirmed in a cohort of German children growing up in non-farm homes with a farm home-like indoor microbiota.

The data suggest that farm-associated bacteria could mediate the asthma-protective effect, and that the protective microbiota was characterized by a high abundance of environmental bacteria (especially soil in suburban homes) relative to human-associated bacteria. Moreover, the protective effect was independent of bacterial richness and total bacterial load and was associated with reduced pro-inflammatory cytokine responses against bacterial cell wall components.

In summary, the study presents an approach to evaluate the composition of household microbiota and the associated risk of children to develop asthma and points to a possible novel intervention strategy to prevent asthma in children living in urban homes.

Andrea Du Toit

ORIGINAL ARTICLE Kirjavainen, P. V. et al. Farm-like indoor microbiota in non-farm homes protects children from asthma development. *Nat. Med.* https://doi.org/10.1038/s41591-019-0469-4 (2019)

FURTHER READING Gilbert, J. A. & Stephens, B. Microbiology of the built environment. *Nat. Rev. Microbiol.* **16**, 661–670 (2018)

IN BRIEF

MICROBIOME

A microbial answer to blood bank shortages?

O type blood is the 'universal donor' type as it can be transfused into nearly all patients with any blood type, but it is often in short supply. Now, Rahfeld et al. report an enzymatic pathway in the human gut microbiome that converts A type blood into the universal donor type, which could lead to an increase in the supply of universal donor blood. ABO blood grouping is determined by antigens on the surface of red blood cells (RBCs). The antigens are carbohydrate structures with terminal sugars, but O type RBCs lack these sugars. The authors performed a functional metagenomic screen of the human gut microbiome for enzymes that remove A and B type sugar antigens from RBCs and found an enzyme pair encoded in the genome of the obligate anaerobe *Flavonifractor plautii* (a *N*-acetylgalactosamine deacetylase and a galactosaminidase) that together efficiently convert the A antigen to the H antigen of O type blood.

ORIGINAL ARTICLE Rahfeld, P. et al. An enzymatic pathway in the human gut microbiome that converts A to universal O type blood. *Nat. Microbiol.* https://doi.org/10.1038/s41564-019-0469-7 (2019)

VIRAL INFECTION

Trafficking precious phage cargo

Eukaryotic viruses exploit microtubule-based transport systems to build progeny virions, but whether phage-encoded cargo traffic along microtubules in infected bacteria was unknown. A previous study found that several *Pseudomonas* phages assemble a bipolar nucleus-like spindle composed of a phage tubulin-like protein (PhuZ) that encloses phage DNA. Using time-lapse light microscopy and cryo-electron tomography, Chaikeeratisak et al. observed that during phage 201φ2-1 infection of *Pseudomonas chlororaphis*, after phage capsids assemble at the membrane, they move rapidly and directionally along treadmilling PhuZ filaments towards the phage nucleus for DNA packaging. Viral capsids become trapped along microtubles when a PhuZ mutant that is defective for GTP hydrolysis is expressed. The spindle rotates the phage nucleus, which the authors hypothesize distributes capsids for efficient DNA packaging. These findings suggest that cytoskeleton-dependent transport is an evolutionarily conserved feature of viruses.

ORIGINAL ARTICLE Chaikeeratisak, V. et al. Viral capsid trafficking along treadmilling tubulin filaments in bacteria. *Cell* https://doi.org/10.1016/j.cell.2019.05.032 (2019)

APPLIED MICROBIOLOGY

Turning off the lights on virus replication

Viruses are promising oncolytic agents in the treatment of cancer and gene delivery vectors for gene therapy and regenerative medicine, but there are safety concerns regarding their use, necessitating the development of fail-safe mechanisms that control viral replication. Tahara et al. report a photocontrollable system for the spatiotemporal regulation of mononegavirus gene expression and replication. Recombinant measles and rabies viruses were generated that express a photocontrollable L protein, the viral RNA polymerase. A 'magnet system' consisting of paired photoswitchable proteins (which heterodimerize upon blue light irradiation) was engineered into the flexible domains of the viral L proteins such that they would activate polymerase activity when they heterodimerize. These viruses could only replicate in the presence of blue light, and viral titres significantly reduced when blue light was removed. Mice bearing cancerous tumours were intratumourally treated with the photocontrollable measles virus and only mice treated under blue light survived.

ORIGINAL ARTICLE Tahara, M. et al. Photocontrollable mononegaviruses. *Proc. Natl Acad. Sci. USA* https://doi.org/10.1073/pnas.1906531116 (2019)