The bacteria can cheat on their mates

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Pursuing our own short term interests by cheating on the rest of the population is not the preserve of the human race. It seems bacteria can operate in just the same way.

Writing in the journal *Nature*, scientists from The University of Nottingham and The University of Edinburgh say bacteria have another trait that might be familiar to us — cooperating for the good of their own family.

Their research has shown that the problem of exploitation, which has been the focus of considerable attention in animal communication, also arises in bacteria. The study could lead to new areas of research in the treatment of infections such as those found in people with Cystic Fibrosis (CF).

For the last ten years Dr Steve Diggle from The University of Nottingham has been working on bacterial cell-to-cell communication. Together with Professor Paul Williams and Dr Miguel Cámara, in The Institute of Infection, Immunity and Inflammation, they have studied the social lifestyle of the bacterium Pseudomonas aeruginosa, the leading cause of death in CF patients. It is also often forgotten as an important cause of hospital acquired infections.

One of the major problems in the CF lung and in the environment is the formation of sticky 'biofilms', slime 'cities' of P. aeruginosa cells that are highly resistant to antibiotics. It is thought that the structuring of these biofilms within the lung is regulated by bacterial cells communicating with each other in a process known as quorum sensing (QS).

Many species of bacteria, including P. aeruginosa, use chemical signals to communicate via QS. It is generally assumed that QS is used to coordinate cooperative behaviours in bacteria that benefit the total population. However, evolutionary theory predicts that cooperation is subject to invasion by social cheaters and liars who pay none of the costs of cooperation but gain all the benefits.

In this current work, scientists have shown that bacterial communication within populations can be disrupted by the invasion of cheater cells who either do not produce the communicative signal or do not bother listening and responding to signals made by other cells. However, bacteria tend not to cheat when dealing with their close kin which is a way of indirectly assuring that their genes are passed into the next generation.

Last year after receiving a 5 year fellowship from the Royal Society Dr Diggle decided to stay at The University of Nottingham and carry on his research into the evolutionary implications of quorum sensing looking at why this type of behaviour occurs and is maintained within populations.

Dr Diggle said: “We can no longer consider bacteria to be single celled entities living and dividing in isolation of each other. They can communicate with each other, preferentially direct aid towards close relatives and even cheat on each other. Bacterial populations are a lot more sophisticated than many people have thought.

Understanding the dynamics within these populations allows us to better understand evolution within chronic infections such as those found in cystic fibrosis and therefore gives us a better chance in the future of finding novel therapies. For example, if cooperation can naturally break down within populations then there is a chance we could use this to our advantage. For bugs like P. aeruginosa, the idea of 'blocking' the cell-to-cell signals has been an attractive proposition for some time. This has become known as 'quorum quenching'. In the laboratory we have successfully used enzymes to break down signals which reduces toxin release.”

The ultimate challenge for the QS team at the University of Nottingham is to be able to successfully treat infections by simply cutting the lines of communication between bacterial cells.

Source: University of Nottingham