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## Kin selection in bacteria

### Study of siderophore production confirms theory in *Pseudomonas* | [By Cathy Holding](#)

In a [letter to Nature](#) this week, [Stuart A. West's](#) group at the University of Edinburgh provides the first empirical data supporting the idea of kin selection in bacteria.

First proposed by [W.D. Hamilton](#) in 1964, the theory of kin selection holds that altruistic cooperative behavior preferentially directed at helping a relative is favored because it helps that relative do better and reproduce, which indirectly helps the cooperator to pass on its genes. "This kind of behavior is very well established in social insects—bees, wasps—also cooperative breeding in vertebrates like birds and mammals," West told *The Scientist*.

The team studied the system of production of siderophores—small molecules that scavenge iron from the environment—in the pathogenic bacterium *Pseudomonas aeruginosa*. Generating these molecules is costly to producer bacteria (cooperators), but others around it can use the siderophores to their own benefit without paying the price ([cheaters](#)).

West's group observed which type of behavior was favored under different conditions, exploiting a serendipitous color difference between producers and nonproducers of siderophores. "What we observed is that when relatedness is high, the cooperators spread to fixation and take over; and when relatedness is low, the cheaters spread to take over," West said, meaning that higher relatedness had a tendency to favor selection for more altruism or cooperation—and confirming Hamilton's theory.

Another more subtle effect of kin selection is the scale of competition—whether competition is local (competition between close relatives) or global (competition between unrelated bacteria of the same species). Relatedness increases cooperation, so that over time, a localized group of highly related organisms emerges. But eventually, these would also become the closest competitors in the local area, "so they were the ones you had to compete with for spots in the gene pool in the next generation," said [David C. Queller](#), professor in the Department of



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## Ecology and Evolution

at Rice University, who wrote an accompanying [News and Views article](#).

The experimental effects of relatedness on the scale of competition explained more than 90% of the variation in the frequency of cooperators versus cheaters at the end of the experiment, West said.

"This study is an empirical demonstration of how those two factors interact. It showed that on the one hand, relatedness is important, but it also showed that this scale of competition matters so that if you are competing only with your closest neighbors, that tends to devalue your neighbors even though you are related to them," Queller, who was not involved in the study, said.

"I guess I was most surprised by how important changing competition was and [the finding] that it was considerably more important than relatedness when relatedness was high," said [Joel L. Sachs](#), postdoc at the University of California at Berkeley's Department of Integrative Biology, adding that the importance of scale of competition in kin selection has been almost completely ignored.

The work has implications for social insects, according to Sachs, who was not involved in the study. "If individual [insects] are close relatives but are going to be dispersing to some other area, or maybe foraging in different areas or looking in different areas for mates, then the scale at which competition might take place is going to vary quite a bit depending on the ecology of that particular insect."

The work confirms the kin selection hypothesis in bacteria, both Sachs and Queller agreed. "It supports the model that they have, that Hamilton created," said Sachs.

"There are a lot of ideas floating around from Steve West's group about how this might be important in natural situations, and having an empirical demonstration working—yes, in the laboratory, but really working—helps," Queller said. "It generates confidence that some of those other [ideas floating around] would be important too."

### Links for this article

A.S. Griffin et al., "Cooperation and competition in pathogenic bacteria," *Nature*, 430:1024-7, August 26, 2004.  
<http://www.nature.com/nature>

Stuart A. West  
<http://westgroup.icapb.ed.ac.uk/index.html>

W.D. Hamilton  
<http://www.guardian.co.uk/obituaries/story/0,3604,230968,00.html>

W.D. Hamilton, "The genetical evolution of social behaviour. I," *J Theor Biol*, 7:1-16, July 1964.  
[\[PubMed Abstract\]](#)

### [Pseudomonas Treatment](#)

Specialists in the prevention and treatment of pseudomonas legionella  
[www.barfieldservices.co.uk](http://www.barfieldservices.co.uk)

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E. Russo, "Microbial co-op in evolution," *The Scientist*, 17:25, October 6, 2003.

[http://www.the-scientist.com/yr2003/oct/research2\\_031006.html](http://www.the-scientist.com/yr2003/oct/research2_031006.html)

David C. Queller

<http://www.ruf.rice.edu/~evolve/dave.html>

D.C. Queller, "Kinship is relative," *Nature*, 430:975-976, August 26, 2004.

<http://www.nature.com/nature>

Joel Sachs

<http://ib.berkeley.edu/labs/simms/JSachs.htm>

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