

Helping in spite of risk: Ants perform risk-averse sanitary care of infectious nest mates

February 21 2018



Garden ant workers interacting with one another. Credit: Roland Ferrigato and Sina Metzler, IST Austria

Ants care for their sick nestmates in different ways, depending on their own immune status. When they themselves are susceptible to dangerous

superinfections, they use a different method to care for sick colony members compared to ants that are not susceptible, thus protecting themselves from infection. This is the result of a study of Professor Sylvia Cremer's research group at the Institute of Science and Technology Austria (IST Austria), with first authors Matthias Konrad and Christopher Pull. The study was published today in the journal *PNAS*.

In colonies, [ants](#) such as the invasive garden ant *Lasius neglectus* live in very confined spaces. This carries the risk that diseases can spread rapidly and threaten the entire colony. Sylvia Cremer and her group have already shown in previous studies that ants of the species *Lasius neglectus* fend off the pathogenic fungus *Metarhizium* by intensively cleaning and caring for colony members whose bodies have been contaminated by fungal spores. In the current study, Sylvia Cremer and her group addressed the question of how the caring ants protect themselves from infection.

Care means protection and risk

There are two ways for ants to care for nestmates—either by grooming off pathogens or by chemically disinfecting them. However, the extensive contact between contaminated and caring ants during care may lead to a transmission of [pathogens](#), which often induces low-level infections that don't cause disease in the caring individual. As the research team has shown in a previous study, such low-level infections of the caring ants stimulate their immune systems and can lead to a protective effect against future infection, similar to variolation, the early form of vaccination used by humans. If this ant comes in contact with the same pathogen again in the future, its defense against the fungal pathogen is already upregulated, and the course of the disease is mild. However, the research team showed that this immunization caused by low-level infections, unlike modern vaccinations in humans, has a cost.

If the ant comes in contact with a second pathogen, it is not only unprotected, but is even more susceptible, which can subsequently cause a highly detrimental superinfection.



Garden ant workers interacting with one another. Credit: Roland Ferrigato and Sina Metzler, IST Austria

Flexible care protects against superinfection

Although ants with low-level infections are more susceptible to superinfections, the researchers show that this altered disease susceptibility affects how ants care for their infectious nestmates. They continue to perform care, but alter how they do so to decrease their risk

of contracting a second infection. This risk avoidance is flexible and depends on the current immune status of the ant. If an ant is protected against a pathogen because it is currently immunized, it grooms the infected nestmate more than non-immunized ants. "This close contact means that the caring ant is exposed to a large number of [fungal spores](#) from the infectious nestmates, but it is less susceptible to them because of previous immune stimulation," explains Sylvia Cremer.

The situation is different when the ant encounters a nestmate carrying a pathogen to which the caring ant is susceptible. If the ant has developed a susceptibility to pathogen B due to a previous [infection](#) with pathogen A, then it sprays the contaminated nestmate carrying pathogen B with formic acid to neutralize the pathogen. This avoids the need for grooming and the close contact that comes with it, preventing pathogen transmission and protecting the caring ant from superinfection. "This risk-averse care improves and maintains the health of the caring animals and thus of the whole colony. In humans, nursing staff and doctors also pay attention to their immune status, for example by vaccinating before entering a dangerous zone. Importantly, ants are capable of this adjustment without the need for vaccination records that humans typically rely on," explains Sylvia Cremer.

More information: Matthias Konrad et al, Ants avoid superinfections by performing risk-adjusted sanitary care, *Proceedings of the National Academy of Sciences* (2018). [DOI: 10.1073/pnas.1713501115](https://doi.org/10.1073/pnas.1713501115)

Provided by Institute of Science and Technology Austria

Citation: Helping in spite of risk: Ants perform risk-averse sanitary care of infectious nest mates (2018, February 21) retrieved 11 May 2024 from <https://phys.org/news/2018-02-spite-ants-risk-averse-sanitary-infectious.html>

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