

Sanitary care by social ants shapes disease outcome

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Argentine ant workers. Credit: Gert Brovad

Sanitary care in ants to fight disease is known to improve the wellbeing of the colony, yet it has been unclear how social disease defense interferes with pathogen competition inside the individual host body. In

their recent study published in *Ecology Letters*, Sylvia Cremer and her research group at the Institute of Science and Technology Austria (IST Austria) revealed that collective care-giving has the power to bias the outcome of co-infections in fungus-exposed colony members.

Who wins in a competition is largely dependent on the opponent faced, yet the role of the environment in which the battle takes place should not be underestimated. In sports, some skiers profit from icy over snowy grounds, and some tennis players are weaker on sand than on grass. Similarly, the [immune system](#) sets the environment for the competition between multiple pathogens that infect an organism at the same time.

It has long been known that an [immune response](#) can bias the competitive outcome of competing pathogens as it may affect one pathogen more than the other. Professor Sylvia Cremer and her team at the Institute of Science and Technology (IST Austria) have now provided the first evidence that it is not only the immune system of the host individual that shapes the competitive outcome of co-infecting [pathogens](#) within the insect body, but that the [social context](#) can have a similar effect.

Survival of the fastest

Solitary species have to fight disease alone. In contrast, in groups of social species—including bees, ants or termites—nestmates often assist the infected individual by providing sanitary care, thereby creating an environment of "social immunity." The Cremer group discovered that besides the immune system of the individual host itself, the sanitary care provided by ants to their fungus-exposed colony members modulates the pathogen competition inside the host's body, changing the success of pathogen outgrowth after infection.

Testing a number of pathogen combinations, Cremer's team found that

one fungal pathogen species that was successful in winning the competition in individually reared ants was much less successful when the ants were reared together with healthy colony members. The researchers discovered that this bias introduced by care-providing nestmates was not caused by selective grooming of one pathogen species over the other. Rather, the [fungal spores](#) showed different susceptibility to the ants' grooming: Spores that quickly enter their host's body turned out to be less susceptible to grooming than spores that need more time penetrating the body surface. Due to this slower germination speed, the respective pathogen was exposed to the ants' grooming for longer than the otherwise weaker competitor.

Cremer says, "If one pathogen species takes longer to germinate, this leaves the ants more time and increases their chance to groom it off. Hence, a fast germination reduces the time window for the ants to perform successful sanitary care and can shift the balance toward winning the competition against a slower-germinating pathogen species."

Social care-giving beats self-cleaning

Pathogens of the genus *Metarhizium* infect insects by attaching to the body surface of their hosts as spores and start germinating. Germinated spores grow a plug-like structure that produces both pressure and lytic enzymes to break the host body surface. They then grow into the host, replicate, kill the host by toxins, and extrude millions of novel spores that cause the next round of infections. Grooming helps ants to effectively prevent these infections.

First author and IST Austria postdoc Barbara Milutinović explains: "The [ants](#) use their mouthparts to pluck off the infectious [spores](#) from the body surface of their nestmates. Such social allogrooming is much more efficient than self-grooming, as some [body](#) parts are impossible to reach by oneself—as we all know from our own experience when we try to

scratch an itchy spot on our own back."

As the Cremer group found, in the presence of grooming nestmates, this social allogrooming can induce a shift in the pathogen community inside the [host](#)—and thus alter the disease outcome.

More information: Barbara Milutinović et al, Social immunity modulates competition between coinfecting pathogens, *Ecology Letters* (2020). [DOI: 10.1111/ele.13458](https://doi.org/10.1111/ele.13458)

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