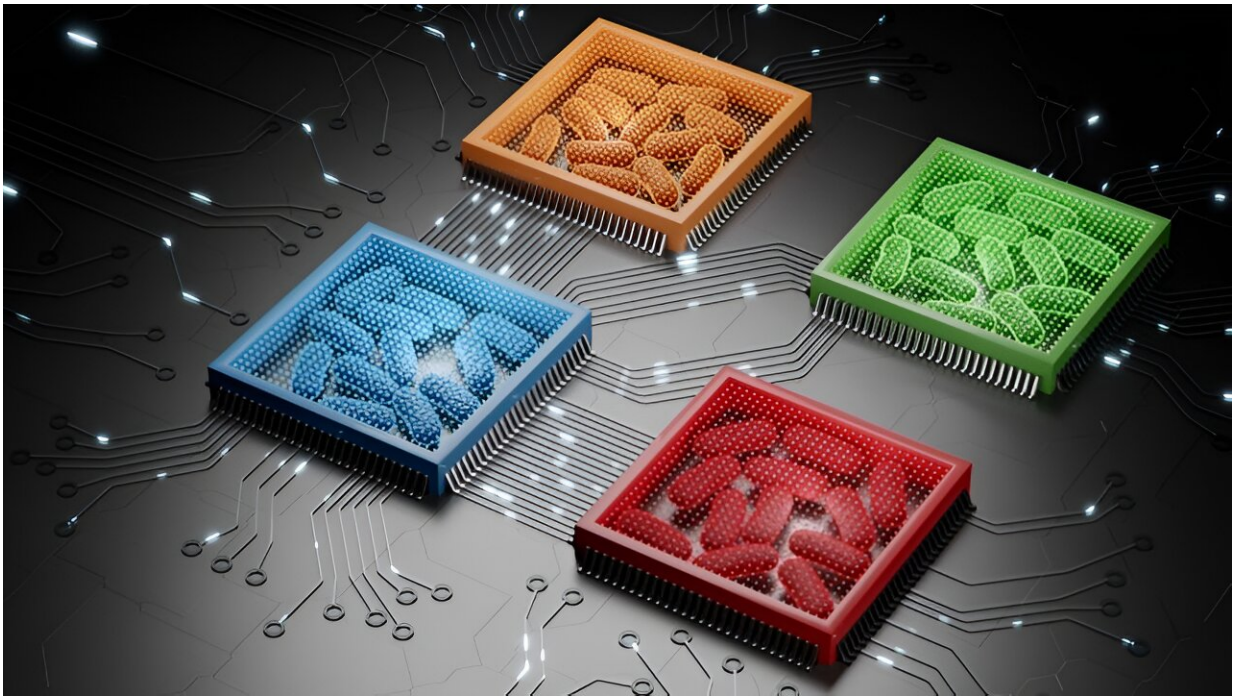
Researchers untangle the relationships between bacterial languages

November 24 2023



An improved understanding of bacterial languages brings us closer to controlling and coordinating the behaviour of bacteria. Credit: Ekaterina Osmekhina/Aalto University

A combination of machine learning and lab experiments has given researchers a peek into the different languages bacteria use to communicate. Understanding how bacteria communicate—and when they can't—has implications for treating drug-resistant bacteria and for

developing biocomputing tools.

The study builds on an earlier project in which the researchers showed that disrupting bacterial communication is an effective way to fight multidrug-resistant bacteria. Bacteria use small molecules to communicate with one another and coordinate infection, and the team showed that interfering with bacterial communication by blocking these molecules reduced inflammation and made the bacteria more vulnerable to antibiotics.

Now, the researchers have taken a closer look at the languages that bacteria use to communicate. The team used a combination of machine learning and wet-lab experiments to examine all the roughly 170 known bacterial languages. This analysis provides an understanding of the similarities and differences between the languages, which can be used both to disrupt harmful bacteria and to build useful "bacterial logic circuits." The findings are published in the journal *Angewandte Chemie International Edition*.

The first step was a machine learning analysis that grouped the languages into clusters based on the structure of their molecules. The resulting groups consisted of languages more similar to each other and different from languages in other groups. This is comparable to human languages: English, French and Dutch are in one group of languages, while Arabic and Hebrew are in another, for example.

Next, the team experimentally showed that bacteria can somewhat understand related languages. "We did a 'bacterial language check' and found that bacteria using very similar languages can understand each other, just like a Dutch person might understand some German. We also tested communication between bacteria using very different languages and found that they couldn't understand each other at all—just like a conversation between people speaking Finnish, Dutch and Arabic

wouldn't get far," says Christopher Jonkergouw, the doctoral student who led the study.

With these tools, the researchers have shown that we can accurately estimate the connections between bacterial languages and predict whether they can be understood. These findings will be valuable in further refining the team's new treatment approach, and they also have implications for biotechnology—bacterial languages can be used to coordinate tasks between groups in bacterial communities, or even in bacterial microprocessors.

More information: Christopher Jonkergouw et al, Exploration of Chemical Diversity in Intercellular Quorum Sensing Signalling Systems in Prokaryotes, *Angewandte Chemie International Edition* (2023). DOI: 10.1002/anie.202314469

Provided by Aalto University