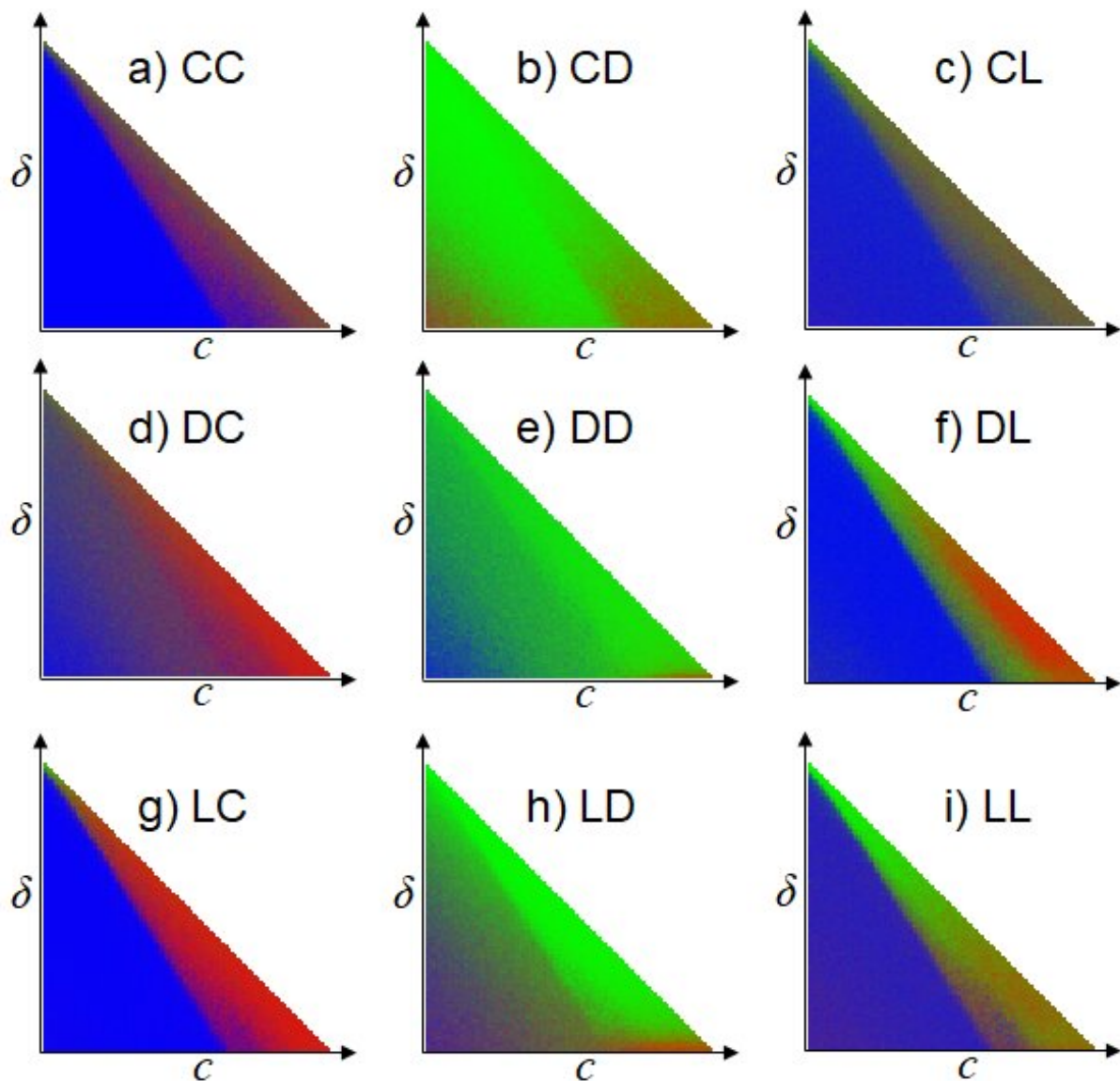


The Prisoner's Dilemma: Exploring a strategy that leads to mutual cooperation without non-cooperative actions

September 23 2019



Phase diagrams of strategy distributions in alternating PDG. Credit: Hitoshi Yamamoto

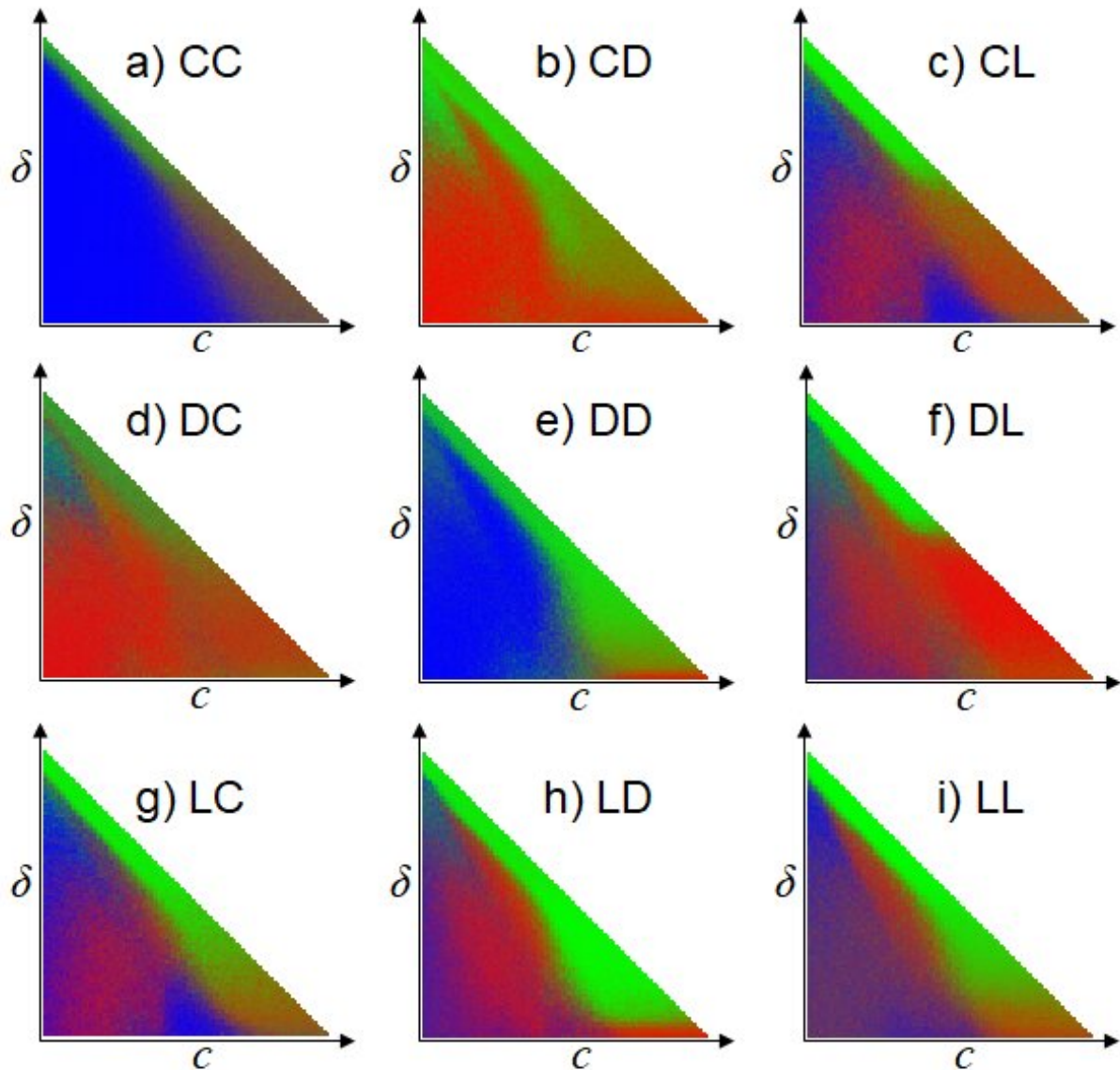
A research team led by Hitoshi Yamamoto from Rissho University has analyzed which strategies would be effective in the prisoner's dilemma game, into which a new behavior of non-participation in the game was introduced. The study was carried out in collaboration with colleagues Isamu Okada (Soka University), Takuya Taguchi (Shibaura Institute of Technology), and Masayoshi Muto (Shibaura Institute of Technology). The results of the study were published in *Physical Review E*.

Cooperation in mutual competition is a basic mechanism for the prosperity of human society. However, the simplest model of cooperation in [game theory](#) predicts that cooperation will not emerge among rational people because [cooperative behaviors](#) incur costs to cooperators, and free riding is a better option.

The team analyzed which [strategy](#) promotes and maintains a cooperative society in a basic model of a social dilemma called the Prisoner's Dilemma by introducing a new action of non-participation in games. While previous studies could only analyze simple combinations of strategies, the research team used agent simulations and developed a method for visualizing more complex simulation results, enabling them to analyze adaptive strategies in an environment where approximately 20,000 strategies coexist and compete with each other.

They determined a strategy that can lead to [mutual cooperation](#) without using non-cooperative actions, even when facing an exploiter. The strategy can be described as "escape interaction if a partner defected or cooperate if a partner escaped interaction."

Yamamoto says that cooperative society can be maintained without using the action of revenge if the action of escape is possible, and this may expand the research on the evolution of cooperation.



Phase diagrams of strategy distributions in simultaneous PDG.

More information: Yamamoto, H., Okada, I., Taguchi, T., & Muto, M. (2019). Effect of voluntary participation on an alternating and a simultaneous prisoner's dilemma. *Physical Review E*, 100(3), 032304. doi.org/10.1103/PhysRevE.100.032304

Provided by Rissho University

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