Achieving optimal collaboration when goals conflict

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New research suggests that, when two people must work together on a physical task despite conflicting goals, the amount of information available about each other's actions influences how quickly and

optimally they learn to collaborate. Vinil Chackochan and Vittorio Sanguineti of the University of Genoa, Italy, present these findings in *PLOS Computational Biology*.

Most previous research into humans' ability to coordinate actions with others has addressed situations in which two people share a common goal, such as transporting a load or operating a tool. Much more often, people's goals conflict, and they must figure out how to collaborate. However, few studies have explored such situations.

For the new study, Chackochan and Sanguineti designed an experimental task in which two participants are assigned to perform different, competing sets of movements using the same mechanical apparatus at the same time. They also used Bayesian statistics and differential game theory to design a computational model that simulates similar partner situations.

Analysis of the experimental results and simulations revealed that, when one has more information about how a partner reacts to one's actions, collaboration is achieved more quickly, and one tends to develop optimal interaction strategies similar to those predicted by game theory. In contrast, with less information about one's partner, a person develops strategies that minimize the need for that information.

The findings provide new insights on the minimal computational machinery needed for stable physical collaboration. Understanding the mechanisms that underlie these kinds of human-human interactions could aid development of robots that can interact with people in a more natural, human-like fashion.

"Game theory has had a huge impact in many fields, including economics, political science, linguistics, operations research, and more," Chackochan says. "Application of game theory in human joint action

may have far-reaching potential, especially in the area of human-robot interaction."

Next, the researchers plan to explore how people achieve and represent knowledge about a partner's ongoing actions and goals. They also aim to work towards development of a bio-inspired virtual agent with built-in collaborative capabilities.

More information: Vinil T. Chackochan et al, Incomplete information about the partner affects the development of collaborative strategies in joint action, *PLOS Computational Biology* (2019). DOI: 10.1371/journal.pcbi.1006385

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