Abstract

One of the most well-known models to characterize cooperation among unrelated individuals is Social dilemma (SD). However there is no consensus about how to solve the SD by itself. Since SDs are often embedded in other social interactions, including indirect reciprocity games (IR), human can coordinate their behaviors across multiple games. Such coordination is called 'linkage.' Recently linkage has been considered as a promising solution to resolve SDs, since excluding SD defectors (i.e. those who defected in SD) from indirectly reciprocal relationships functions as a costless sanction. A previous study performed mathematical modeling and revealed that a linkage strategy, which cooperates in SD and engages in the Standing strategy in IR based on the recipients' behaviors in both SD and IR, was an ESS against a non-linkage strategy which defects in SD and engages in the Standing strategy in IR based on recipients' behaviors only in IR (Panchanathan & Boyd, 2004, *Nature*, *432*(7016), 499–502). In order to investigate the robustness of the linkage strategy, we devised a non-linkage strategy, which cooperates in SD but does not link two games. First, we conducted a mathematical analysis and demonstrated that the linkage strategy was not an ESS against cooperating non-linkage strategy. Second, we conducted a series of agent-based computer simulations to examine how the strategies perform in situations in which various types of errors can occur. Our results showed that the linkage strategy was an ESS when there are implementation errors in SD, but not when there are perception errors. Since we know that humans are not free from perception errors in their social life, future studies will need to show how perception errors can be overcome in order to provide support for the conclusion that linkage is a plausible solution to SDs.