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# Combination with anti-tit-for-tat remedies problems of tit-for-tat

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## Abstract

One of the most important questions in game theory concerns how mutual cooperation can be achieved and maintained in a social dilemma. In Axelrod's tournaments of the iterated prisoner's dilemma, Tit-for-Tat (TFT) demonstrated the role of reciprocity in the emergence of cooperation. However, the stability of TFT does not hold in the presence of implementation error, and a TFT population is prone to neutral drift to unconditional cooperation, which eventually invites defectors. We argue that a combination of TFT and anti-TFT (ATFT) overcomes these difficulties in a noisy environment, provided that ATFT is defined as choosing the opposite to the opponent's last move. According to this TFT-ATFT strategy, a player normally uses TFT; turns to ATFT upon recognizing his or her own error; returns to TFT either when mutual cooperation is recovered or when the opponent unilaterally defects twice in a row. The proposed strategy provides simple and deterministic behavioral rules for correcting implementation error in a way that cannot be exploited by the opponent, and suppresses the neutral drift to unconditional cooperation.

*Keywords:* evolution of cooperation, prisoner's dilemma, reciprocity, memory

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