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Referee report: Cooperation in the Finitely Repeated Prisoner’s Dilemma

Embrey, Fréchette, and Yuksel, 2017

The authors examine a long-standing discrepancy between theory and empirical evidence on cooperative behavior in a finitely repeated prisoner’s dilemma game. Theory predicts that a participant, given enough experience, should approach a strategy of “always defect” (AD) based on the logic of backward induction from the final-round Nash equilibrium of non-cooperation. Yet the experimental literature is inconclusive about whether participants learn this strategy.

The importance of this paper lies not in trying to explain cooperation in terms of existing theories (e.g. Kreps et al 1982, Radner 1986), but rather in developing a convincing explanation, based on meta-analysis of prior research supplemented with their own experiment, for the emergence and eventual breakdown of cooperation with experience. The authors offer significant evidence that initial cooperation is highly dependent on the game parameters, and find that with experience participants learn to use threshold strategies (conditional cooperation until some threshold round, at which point cooperation ceases). Importantly, the authors find that when controlling for behaviors inconsistent with such a strategy, data from the meta-analysis and their own experiment show a threshold advancing earlier and earlier as consistent with backward induction.

The authors convincingly debunk the “folk wisdom” that initial cooperation (as opposed to “always defect”) is due to the cognitive difficulty of backward induction over longer horizons. Their meta-analysis is thorough and provides convincing evidence to show that a “basin of attraction of always defecting” (*sizeBAD*) statistic better explains initial cooperation than the horizon alone. This in turn provides an opening for an elegantly designed experiment, in which horizon varies while the *sizeBAD* remains constant. Their conclusion is far more interesting and seems to bear important implications for cooperation in PD games in general: that a more distant horizon increases first-round cooperation by increasing the value of conditional cooperation.

The learning model, simulations, and counterfactuals are interesting and well considered though perhaps less immediately applicable than the understandings from the meta-analysis and experiment. They offer insights into how the stage game parameters might influence the rate at which participants learn to apply a threshold strategy earlier and earlier, as predicted by backward induction. Interestingly, the simulation suggests that for games with a higher time horizon and “easy” stage game parameters, cooperation often occurs well into the game even after an extended period of learning, and though cooperation appears to unravel over time, it does so quite slowly.

I would recommend accepting this manuscript contingent upon one minor revision and consideration of one suggestion.

As a minor revision, please address the role of stakes in the conclusions of the meta-analysis and novel experiment. The important understandings from this paper focus on how cooperation is affected by the environment, generalized to the basin of attraction statistic, which is independent of stakes. The data used in the meta-analysis is understandably normalized such that reward = 1, punishment = 0, and gain/loss relative to these values. But neither in the main text nor in the appendices is any mention made of the stakes in each experiment included in the meta-analysis or their relation to those in the authors’ experiment. It may very well be that prior research shows that similar experiments are not particularly sensitive to stakes, or that this question must be left for future exploration. No further analysis should be necessary; however, the absence of any acknowledgment of the possible role of stakes seems problematic.

As a suggestion, please consider commenting on the confidence around the results of the simulations, in which parameters based upon 30 observed supergames are extrapolated to 1000+ simulated supergames. In figure XI and figures A11, A13, A14, particularly in early rounds, a steep dropoff is predicted by the simulations after 30 supergames, while the experimental data, limited to 30 supergames, ends before any such dropoff is observable or even hinted at. How sensitive is the learning model to variations in the parameters? In particular the κ term, describing how implementation errors change over time, varies by thirteen orders of magnitude from one treatment to another (see tables A15 and A16) and β-bar for the D4 treatment is fourteen orders of magnitude greater than that for other treatments.

Overall, this is an excellent and thorough exploration of cooperation and the breakdown thereof in a classic situation. The results and conceptual understanding could have important implications for design of policies to support collective action and provision of public goods by aligning the parameters to promote, or at least slow the unraveling of, cooperative action.