

Timing uncertainty promotes group reciprocity and polarization in the presence of risky commons

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Abstract:

Anthropogenic climate change, public health measures or even group hunting, are some of the many collective endeavors characterized by uncertain, long-term and non-linear returns. We operationalize these scenarios in a collective-risk dilemma, where players can invest into a public good throughout a number of rounds, and will only observe their payoff when the game ends. The non-linearity of returns is modelled through a threshold that determines the risk of collective loss. This risk is able to transform a traditional public goods game, where players incur in the well-known *tragedy of commons*, into a coordination game, where success depends on surpassing a coordination barrier. Behavioral experiments indicate that, when the risk of collective loss is high, about half of the experimental groups are able to coordinate and avoid the *dangerous* threshold. However, uncertainties over environmental variables, such as the placement of the threshold, revert the game back into a prisoner's dilemma, decreasing group success. Here we show experimentally the effect of uncertainty about the number of rounds the game will take, i.e., how much time the players have to avoid the consequences of surpassing a dangerous threshold.

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Surprisingly, our results indicate that, for low levels of this *timing uncertainty*, not only collective success does not decrease significantly, but we observe a behavioral shift. Contrarily to what happens when there is no uncertainty, participants invest earlier and in a more polarized manner. Also, a detailed behavioral analysis of the experimental data reveals that, under timing uncertainty, participants of successful groups tend to reciprocate in a similar fashion to the group analogous of the Tit-for-Tat strategy, where players only increase their investments if the group does the same. We confirm these conclusions through a stochastic model of population dynamics that represent the dominance relationship between the strategies observed experimentally. The model shows that reciprocity becomes more dominant as timing uncertainty increases. In general, we observe that timing uncertainty requires earlier investment to trigger group reciprocation and maintain group success.