Evolution of Fairness in Multiplayer Ultimatum Games

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Fairness plays a determinant role in everyday interactions. Its influence is often strong enough to overcome rationality and selfishness, posing challenges to mathematical models that aim to incorporate the complexity of human interaction contexts and justify fair behaviour (Fischbacher et al., 2009; Thaler, 1988). Although traditionally studied in the case of two person interactions, fairness is also involved in processes of collective decision where groups provide the actual contexts that may, or may not, stimulate fair outcomes (Messick et al., 1997; Fischbacher et al., 2009; Kauffman et al., 2010; Santos et al., 2015). Nevertheless, moving from a two-player game to a multiplayer scenario may introduce interaction features whose influence in the strategic reasoning of individuals is neither clear nor straightforward to treat mathematically. In this abstract we focus in an interaction paradigm (Multiplayer Ultimatum Game, MUG) in which individuals are given resources that should divide with groups (Santos et al., 2015). Groups, in turn, need to deliberate upon acceptance or rejection. As in the traditional pairwise Ultimatum Game (Güth et al., 1982), acceptance yields to each player the payoff corresponding to the accepted proposal (the group divides evenly the offer and the proposer keeps the remaining) and rejection precludes any payoff gain.

While the deliberation process of groups can be arbitrarily complex in real-life situations, in MUG we focus on a straightforward map between individual choices and final group decisions: we assume that a proposal is accepted by the group if a minimum quorum of responders in the group individually accepts that proposal. For that, we use M (the minimum number of individual acceptances to have a group acceptance) and N (the group size) to test different group decision environments (Santos et al., 2015).

Using the traditional solution concepts of classical game theory (in this specific case, sub-game perfect rationality (Osborne, 2004)), the effects of N and M would be completely overlooked, regarding an analysis of the most likely strategies used by individuals. Indeed, assuming individuals' rationality, proposals should be unconditionally accepted as rejection ever yields a payoff of 0. This way, pro-

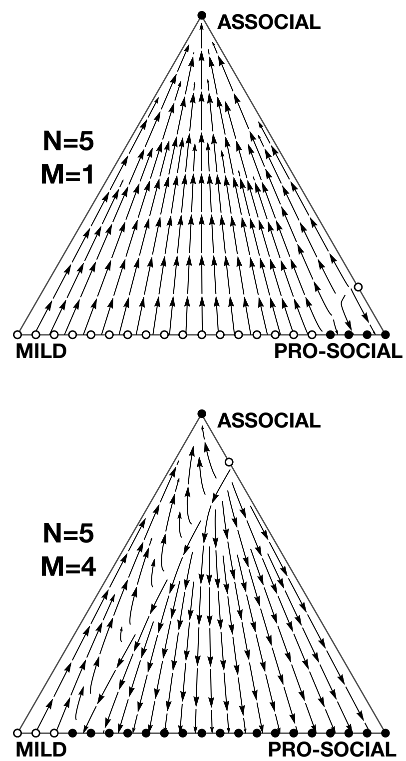

Figure 1: Replicator dynamics of MUG, using a minigame analogous (Gale et al., 1995; Nowak et al., 2000). M has an important role in the size of the attraction basin towards the population configurations where high and fair proposals are made, suggesting that a high M induces higher proposals. When using the PRO-SOCIAL=$(0.5, 0.5)$ strategy, individuals propose 0.5 and only accept proposals higher than 0.5; ASSOCIAL=$(0.1, 0.1)$; MILD=$(0.5, 0.1)$

posals are always accepted by groups independently of N and M, leading one to exclude any influence that this parameters could have on decision making of Proposers and on the consequent average proposal values. However, M and N are likely to have a non-negligible impact in daily human decisions.

In this context, Evolutionary Game Theory (EGT) proves to be useful in evaluating the course of populations of individuals interaction through MUG, how this process depends on N and M, and concomitantly, how these parameters turned to be influent in human decision making. With this work, we seek to summarise our recent effort in applying EGT tools to analyse MUG, both considering unstructured and structured populations.

So far, using replicator dynamics (Figure 1) and large-scale numerical simulations (with inherent stochastic effects) we conclude that: 1) higher values of M induce higher – and fairer – average values of proposal (Santos et al., 2015); 2) the effect of N is highly dependent on the fixed value of M (Santos et al., 2015) and 3) there is a particular class of networks (where influence between individuals is augmented) that maximises fairness in the context of MUG (Santos et al., 2016).

In this workshop, we seek to present an overview of these recent results and broaden the discussion regarding potential applications of EGT tools to describe and analyse the behaviour of group interactions where fairness is certainly paramount.

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