Effects of "Physical Body" on Biased Opponent Selection in the Iterated Prisoner's Dilemma Game

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1 Introduction

This paper investigates methods for improving cooperation in the evolutionary Iterated Prisoner's Dilemma game (IPD): the tag-based approach [Riolo1997] and the space-based approach [Oliphant1994]. The two methods are similar in that both use a bias in selecting opponent to play the game; however, there is an important difference between the two. In Riolo [Riolo1997], this difference is considered as a "significant difference" of the space-based model from the tag-based model; he states "the tag space is not a scarce resource in the way spatial space usually is."

The space-based approach has the space limitation since each agent occupies a position on the one-dimensional space. The tag-based approach, however, has an unlimited real number tag-space. The metaphor is that each agent in space-based approach has "physical body" while the agents in the tag-based approach don't. The space limitation is not a negative aspect of the space-based approach; on the contrary, it is the driving force for the evolution of cooperation.

The experimental results show that the clusters of the similar kinds – either of defectors or of cooperators – can emerge more effectively with the space-based model; the space-based model can squeeze out dissimilar kinds away from the *kin clusters.* In the tag-based model, however, the real number tag space is unlimited, therefore, new offspring with dissimilar game-playing strategies (i.e., cooperate or defect) can have the same or very similar tag values. The kin clusters aid the biased opponent selection mechanism; the probability of cooperators playing cooperators and defectors playing defectors will increase as such clusters emerge.

2 The Model

Oh [Oh1998] present a new model that emphasizes the squeeze out ability of the space-based model yet has enough space to accommodate a large number of agents. This new model will allow several different ways of squeeze out – called *conflict resolution schemes* – while the original space-based approach allows only one way.

There are many conflict resolution schemes (see [Oh1999] and [Oh1998]). I present only two here: (1) *Replacing the lowest performing agent in the cluster where the new agent belongs:* This method squeezes the lowest performing individual out of the possible kinship cluster. If the kinship cluster consists mostly of cooperators, the lowest performing individual may be the frequent victim of a nearby defector. By squeezing out the victim, the defector may lose the "sucker." I call this *victim relocation method.* (2) *Replacing the highest performing agent*: In this method, we squeeze out the highest performing individual in the kinship cluster. The idea behind this is to squeeze out defectors within cooperators' clusters. This is a form of ostracism that evicts non-kin or potentially harmful individuals out of the cluster. I call this as *parasite removal method.* Details of the conflict resolution schemes can be found in [Oh1999] and [Oh1998].

References

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