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Prof. Dr. Spencer C.H. Barrett  
Editor-in-Chief

Proceedings of Royal Society B

# Max Planck Research Group Dynamics of Social Behavior

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Dear Prof. Dr. Barrett,

I am pleased to submit our research paper entitled “**Evolution of reciprocity with limited payoff memory**” by Nikoleta E. Glynatsi, Alex McAvoy and Christian Hilbe for your consideration for publication in *Proceedings of the Royal Society B*.

Direct reciprocity is one of the key mechanisms to explain the evolution of cooperation among unrelated individuals. Corresponding models suggest that individuals naturally learn to adopt conditionally cooperative strategies when repeatedly interacting with the same partner. Yet many of these models make rather strong assumptions on the individuals’ cognitive abilities. In particular, they assume that individuals update their strategies based on their expected payoffs. Such an assumption essentially requires individuals to remember (or compute) their payoffs against everyone else in the population. This assumption appears unrealistic for humans, and even more so for other animal species. In our article, we explore whether such a strong assumption is in fact necessary for the evolution of reciprocal cooperation.

More specifically, we compare a traditional model of direct reciprocity with several alternative models that take into account different memory constraints. For example, in one setting we study the evolutionary dynamics when individuals update their strategies based on their last interaction with their last interaction partner. In other settings, we gradually allow individuals to take into account events more distant in the past. Our findings, derived from a combination of analytical methods and computer simulations, reveal that even in the most extreme case where individuals take into account only their last interaction, cooperation can still evolve. However, in that case, individuals tend to be less generous, and they cooperate less often than in traditional models. Intriguingly, as individuals remember the payoffs of two or three recent interactions, the evolving cooperation rates quickly approach the traditional baseline.

Our findings shed an interesting light on the role of cognitive constraints on the evolution of reciprocal altruism. While some elementary form of payoff memory is necessary for reciprocity to evolve, it is reassuring to find that the required memory capacities are rather moderate. In most cases, already remembering a few interactions is sufficient for reciprocal altruism to evolve.

We believe that our paper aligns with the scope and objectives of *Proceedings of the Royal Society B* and will contribute to the ongoing scientific discourse in the field of cooperative behaviors. Therefore, we would be delighted if this article could be considered for publication in your journal.

As handling editors, Sarah Brosnan and Hans Heesterbeek (senior editors), and Daniel Coombs (associate editor) would certainly be excellent candidates. As potential referees, we would like to suggest the following:

* **Bin Wu** ([bin.wu@bupt.edu.cn](mailto:bin.wu@bupt.edu.cn), Beijing University of Posts and Telecommunications) has written many papers on direct reciprocity and on evolutionary game dynamics more generally.
* **Daniel B. Cooney** ([dbcoone2@illinois.edu](mailto:dbcoone2@illinois.edu), University of Illinois Urbana-Champaign) is a mathematician interested in theoretical biology and the evolution of cooperation.
* **Kaleda Krebs Denton** ([kaleda@stanford.edu](mailto:kaleda@stanford.edu), Stanford University) is a biologist with ample experience with models of cultural evolution.
* **Elias Fernández** ([elias.fernandez.domingos@vub.be](mailto:elias.fernandez.domingos@vub.be), Vrije Universiteit Brussels) is an expert on game theory and experiments with human subjects
* **Manon Schweinfurth** ([ms397@st-andrews.ac.uk](mailto:ms397@st-andrews.ac.uk), University of St. Andrews) explores direct reciprocity in various species, including Norway rats.

Thank you for considering our submission.

With kind regards,

On behalf of the authors,

Nikoleta E. Glynatsi

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