

Direct and Indirect Reciprocation



Lucas Molleman*, Eva van den Broek**, Martijn Egas*

*IBED (Institute for Biodiversity and Ecosystem Dynamics), in cooperation with
**CREED (Center for Research in Experimental Economics and political Decision-making)
Department of Economics and Econometrics, University of Amsterdam
Lucas.Molleman@student.uva.nl

Cooperation

Experimental economics applies laboratory experiments to study the economic decision making of human subjects. Experiments are aimed at the evaluation and systematic deviations of game-theoretic predictions, for instance at documenting the individual 'social preferences' like altruism and spite. The experiments are cash-motivated in order to induce real incentives.

One of the aims of **evolutionary biology** is the development of mathematical and computational models to gain insight in animal behaviour. Predictions of the models may be contrasted with data sets and experimental results.

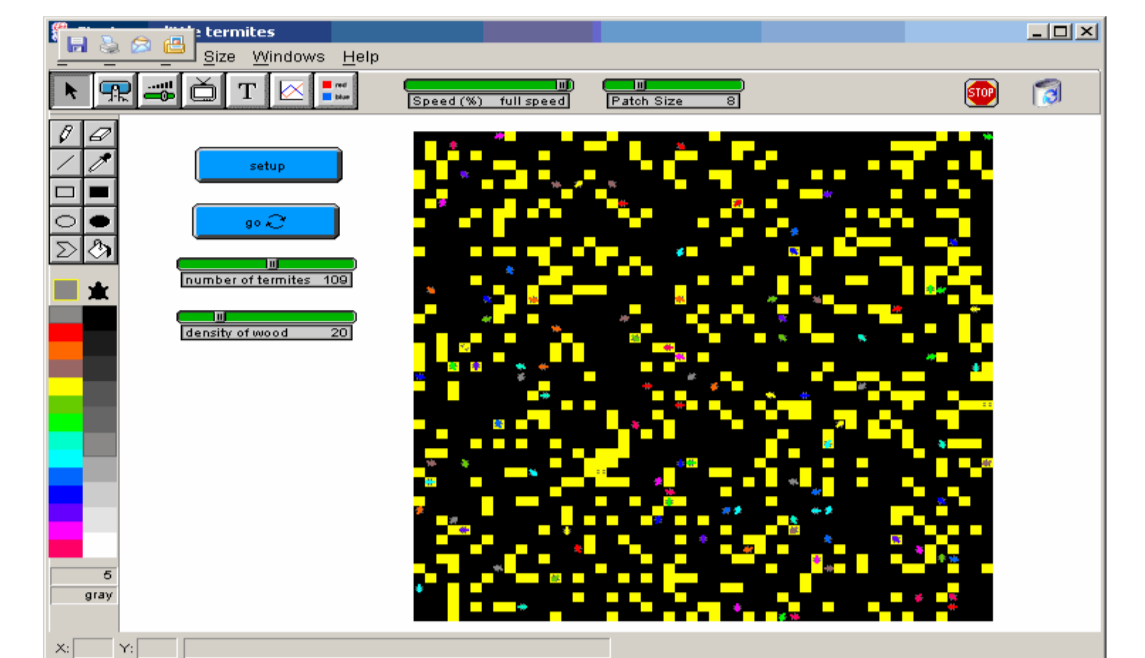


Laboratory experiments (economics):

- actual social behavior of human subjects
- controlled laboratory environment
- “real” incentives and institutions

Theory (biology):

- models of adaptation and co-evolution
- framework for experimental design
- explanation of experimental observations



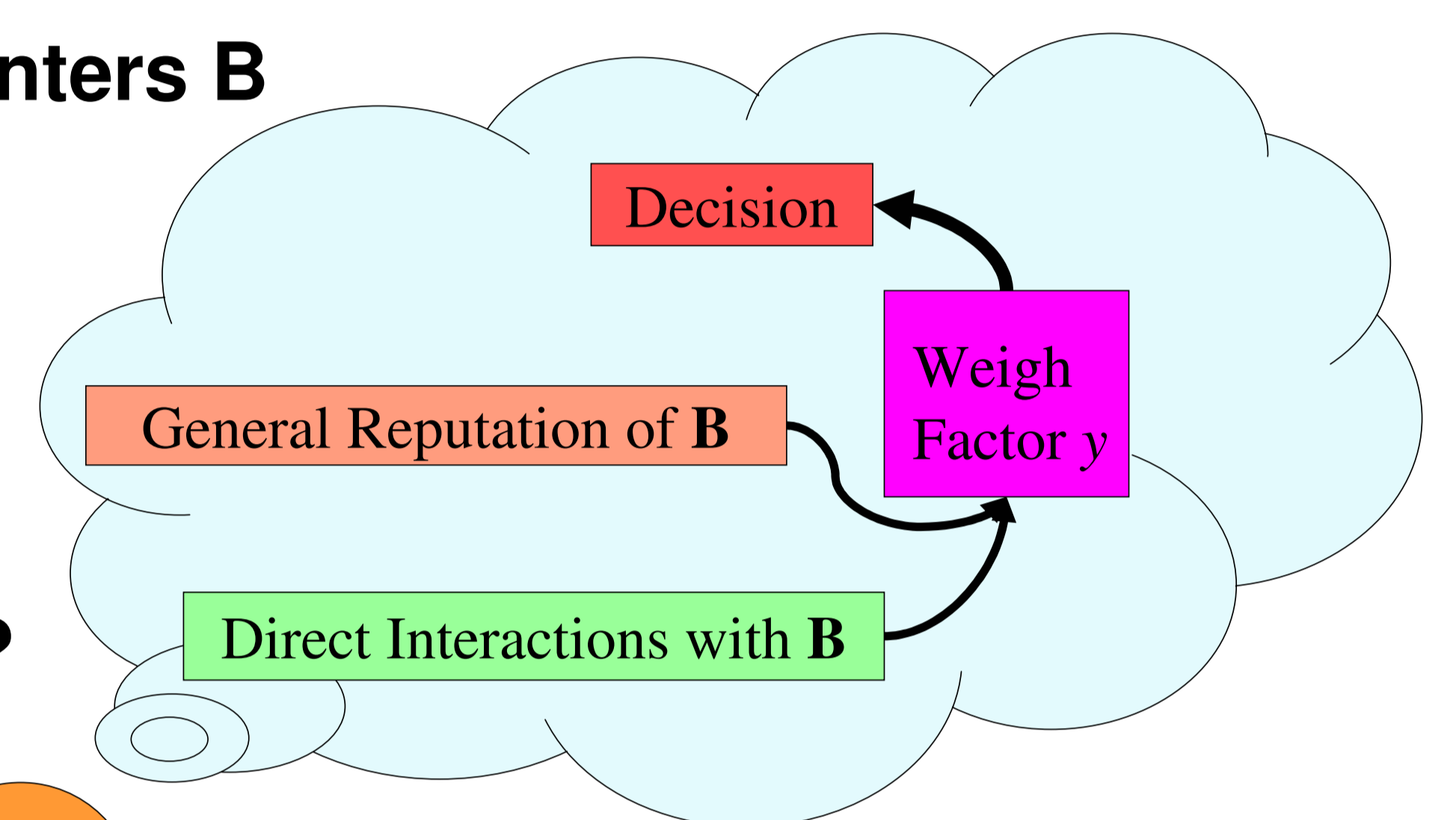
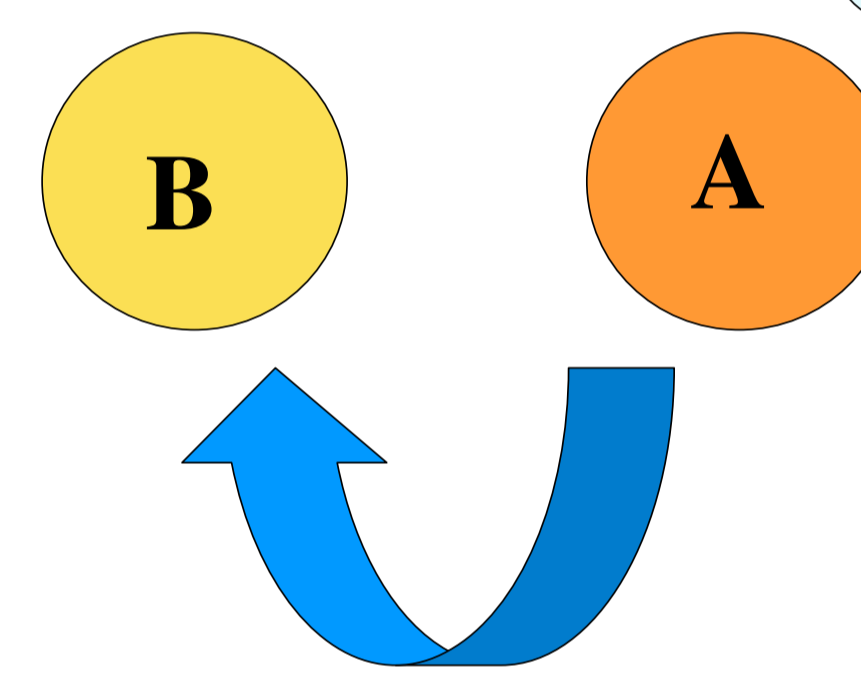
Research

In both evolutionary biology and economics, classic theories assume individuals to act selfishly. Cooperation can nevertheless be established through mechanisms like both direct and indirect reciprocity. These principles supporting cooperation are most often studied separately. For their decisions to help others people may take both personal experience and reputations into account, to varying degrees. Our study uses simulations to predict which strategic combinations of reciprocal strategies are evolutionarily stable. A subsequent computerised economic experiment tests these predictions in a helping game. Human subjects were given the choice to base their (non-) helpful decisions on two types of costly information (*i.e.* direct or indirect).

Experimental economics and evolutionary biology provide complementary research tools. Combining the expertise in both fields gives rise to a theoretical backbone and crucial testing of hypotheses to understand the nature of human cooperation.

When A encounters B

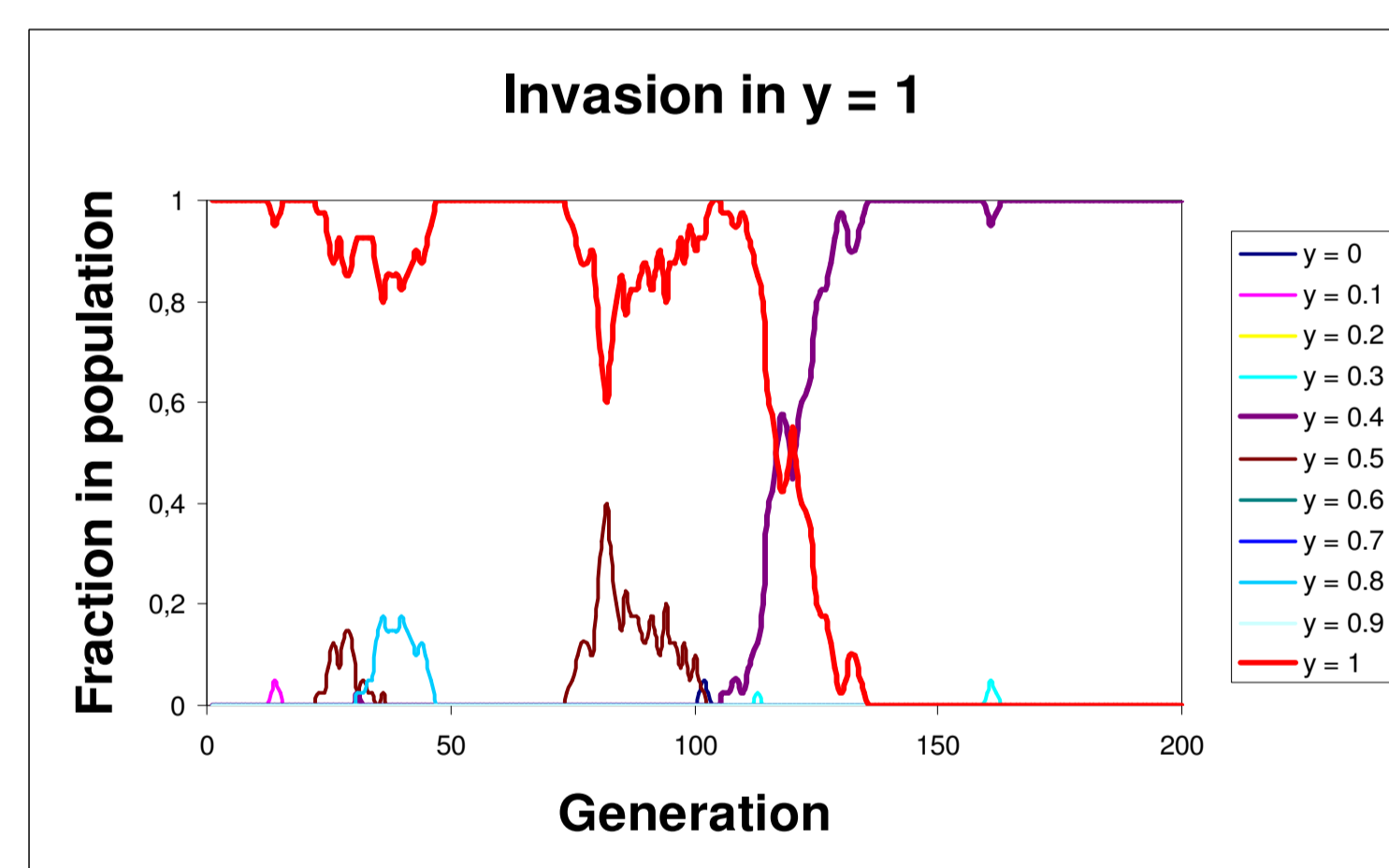
Help / no-help?



In this helping game, agents in a population are randomly matched in pairs, and assigned a role of either donor (A) or recipient (B). Before A decides to 'help' B (*i.e.* enhance B's fitness at a cost for himself), A can request information on previous decisions of B, when B was in the role of donor.

Simulation

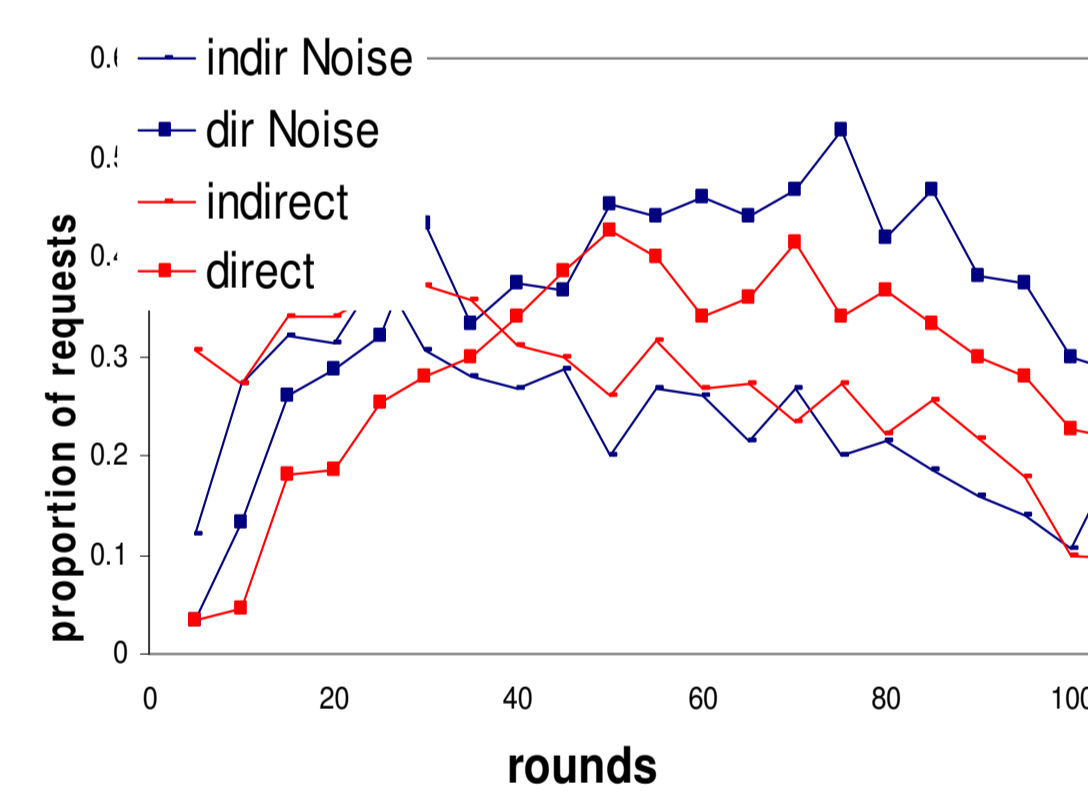
Invasion analysis assesses the evolutionary stability in a population (N=40) of strategies based on direct reciprocity only ($y = 1$). Mutations allow other strategies (using reputations to varying degrees (0; 0,1; 0,2 ... 1)) to originate.



Invasion of a resident $y = 1$ strategy by other strategies taking reputations into account at varying degrees

Main findings: strategies using the reputation of other agents (indirect information) can invade strategies using direct information only. No specific dominant alternative strategies could be identified.

Experiment



In case of a tie, people generally rely on direct information. Correlation between the number of cooperative choices and the times being helped previously by others is very high (0.88).

In a repeated helping game (100 rounds), help was given in 49 % of all interactions. People request both types of information, and react to noise – not by lowering their propensity to help, but by switching to direct information.

	No-noise		Noise	
	Positive score	Negative score	Positive score	Negative score
Direct info	85 %	10 %	81 %	4 %
Indirect info	85 %	18 %	70 %	32 %

Conclusion and discussion

Our simulations showed that the use of reputations can have a selective advantage in a population in which all decisions are based on personal experience. The experiment pointed out that people indeed use both types of information, but assign more weight to direct information when deciding whether or not to reciprocate earlier behaviour of a recipient. Lowering the reliability of reputation does not affect cooperation levels, but increases the number of requests for direct information.

Collaboration

This study at the crossroads of evolutionary biology and experimental economics shows that collaboration between these two fields can yield new insights. Economic theory could not predict which behavior would be optimal under the circumstances of our experiment. The results from the biological invasion analysis showed that reputations could be used without loss of earnings. The fact that this was corroborated by the experimental results shows that the two disciplines have complementary qualities that merit cooperation.