



Evolutionary Game Theory

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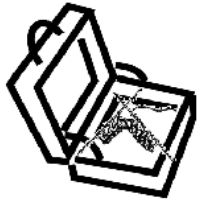
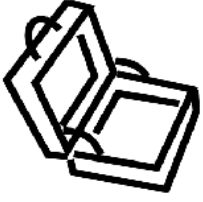

Cooperation

- Two meanings: evolutionary and social
- Evolutionary: behaviors that benefit other members of the same species
- Social: choices that are beneficial to the society
- Often a trade-off between helping the whole as opposed to the self



Prisoner's dilemma

- One of many possible games

	 b - c	 -c
	b	0

- $$P = \begin{bmatrix} b - c & -c \\ b & 0 \end{bmatrix}$$



Game theory evolving

- No assumptions about rationality
- Study populations of simple agents

Evolving cooperation:

- Kin selection
- Direct reciprocity
- Indirect reciprocity



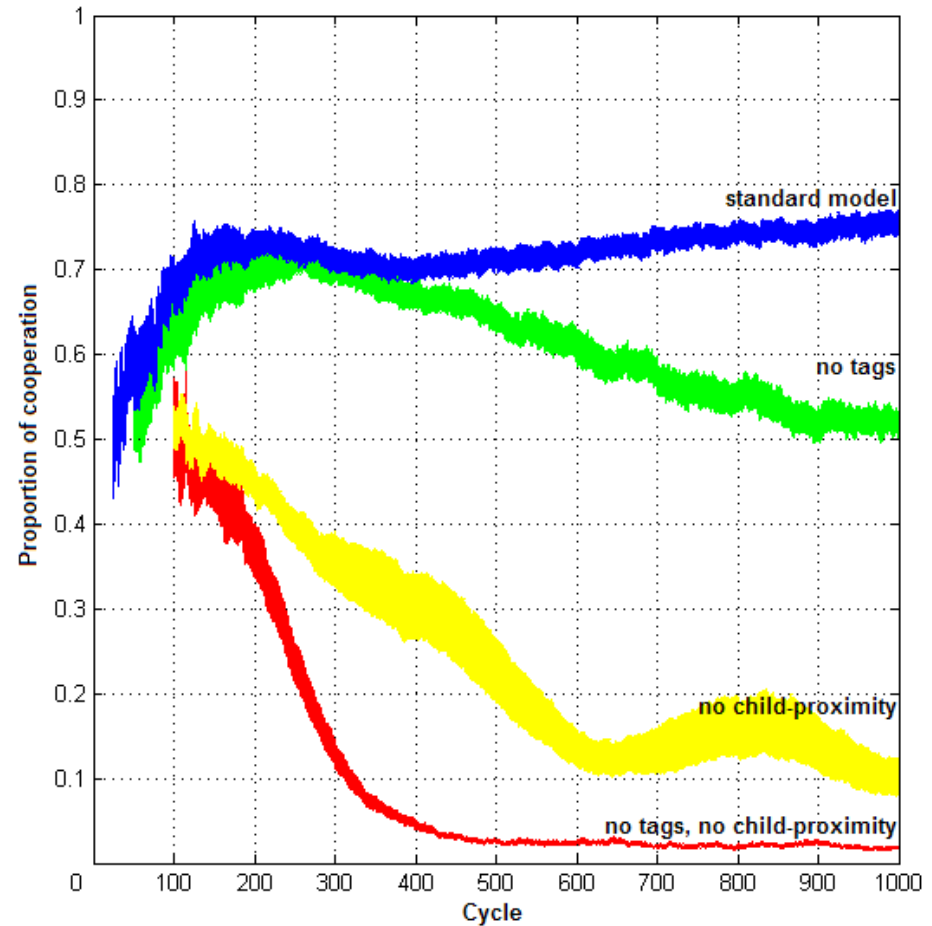
Green-beard effect

- Arbitrary tag used to guide behavior
- Allows a dual strategy, one for same-tag and one for different-tag
- Cooperation with same-tag, defection against different-tag
- Known as ethnocentrism in humans



Simulations

- Study of Hammond and Axelrod's 2006 model
- Tags help maintain cooperation; local child placement creates it





Some math

$$U(\mathbf{a}; \mathbf{b}, r, \rho_b) = r\mathbf{a} \cdot (\mathbf{P} + \mathbf{Q})\mathbf{a} + \rho_b \mathbf{a} \cdot \mathbf{P}\mathbf{b}$$



General applications

- Better understanding of biology
- Cancer research
- Self-organizing behavior
- Peace building and conflict resolution
- Distributed computing



Further research

- Analysis of cooperation-defection transitions
- Simpler methods for creating and sustaining cooperation
- Evolutionary games on graphs