Cooperation

Emergence in complex systems

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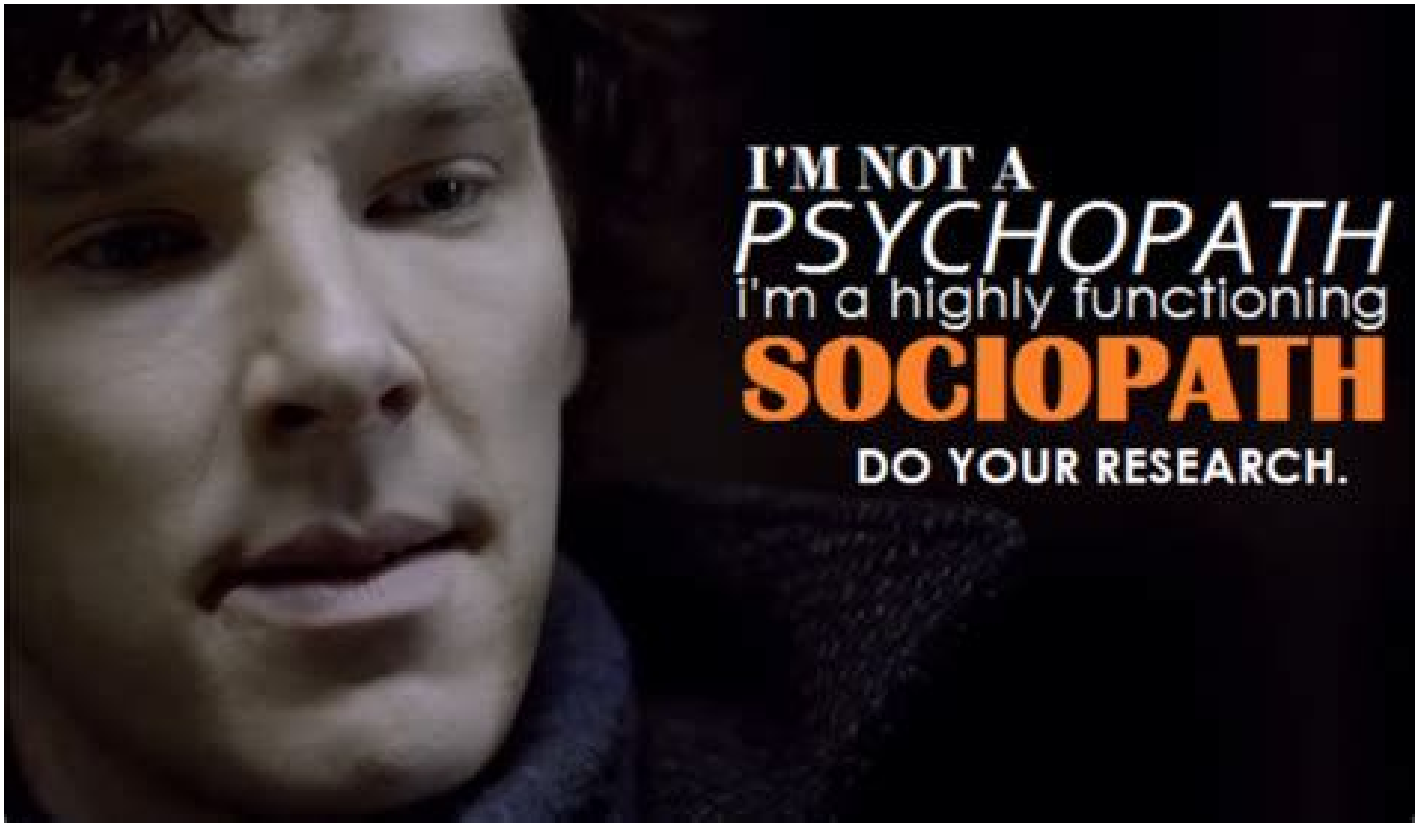
DEC

Why altruism?



Economist: :(
(Game Theory // Nash equilibrium)

Biologist: :) (?)
(Evolutionary Game Theory // ESS, which resist *mutant* strategies)

Golden Balls

The Prisoner's dilemma

Prisoner B \ Prisoner A	C	D
C	$(-1,-1)$	$(-20,0)$
D	$(0,-20)$	$(-10,-10)$

Years in prison faced by both prisoner's depending on their actions (cooperate or defect on the other)

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$\rightarrow$ *The only ESS for the prisoner's dilemma is* (D, D)

The Prisoner's dilemma

Benefit of help: b
Cost of helping someone else: c
Benefit of mutual cooperation: $b - c > 0$

		Chooser	
		A	R
Signaler	C	$(b-c, b-c)$	$(-c, b)$
	D	$(b, -c)$	$(0, 0)$

Payoffs for a typical cooperative dilemma

$\rightarrow$ *The only ESS for the prisoner's dilemma is* (D, D)

So why do we manage to cooperate ?

https://ncase.me/trust/

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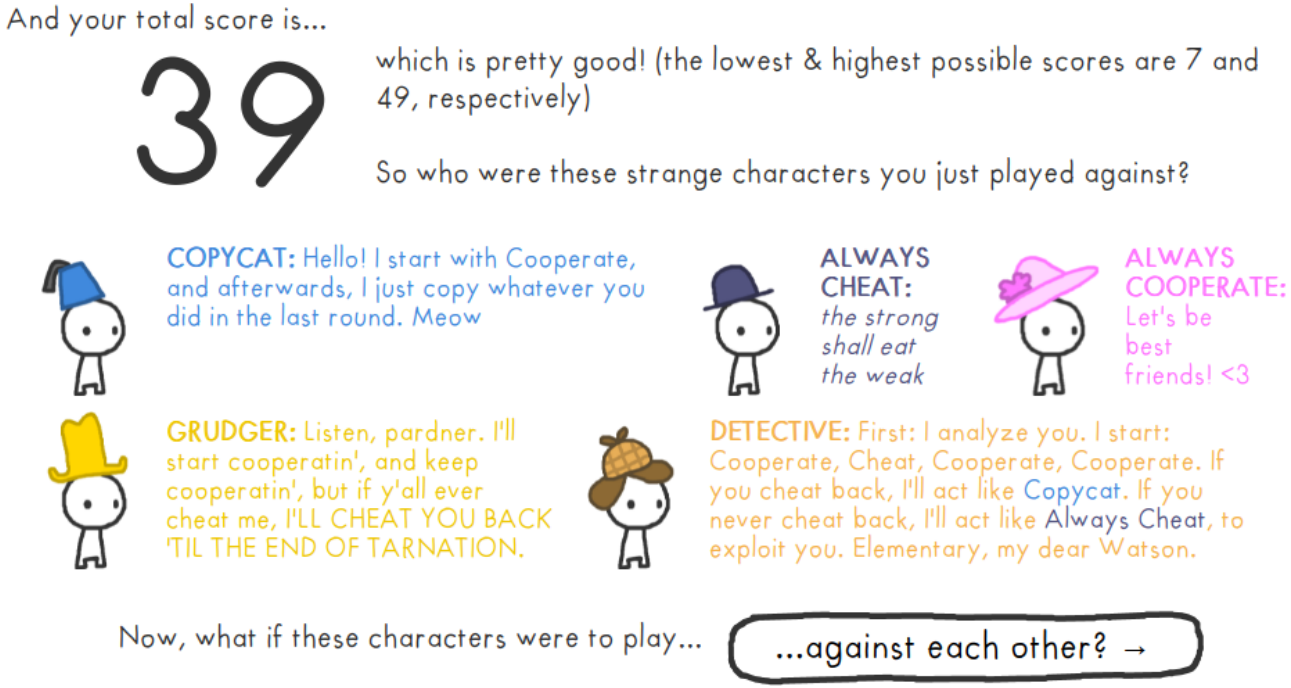

Tournament

What about when players enter in indefinitely repeated interactions (probability of ending μ)? How do you think will win the "tournament":

A) A pure defector, who always plays D — and thus exploits others' generosity

B) A pure cooperator, who always plays C — and thus benefits from repetition when encountering other cooperators (as they gain $b - c$ for several rounds)

C) "Tit-for-tat": a player who starts of by playing C and then just repeats the other players' last interaction.

D) Some other more complex strategy, which figures out others' player strategy in the first few rounds, using a neural network

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Reciprocal cooperation

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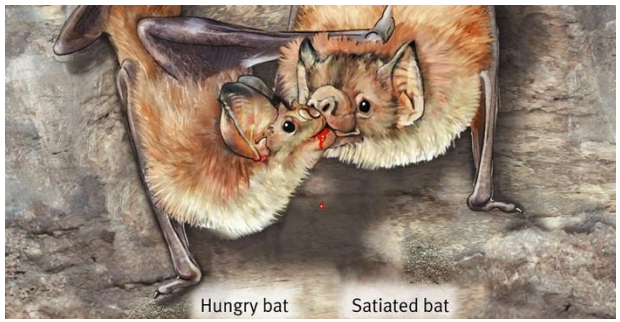
Refinement: indirect reciprocity and reputation
[Nowak and Sigmund, 1998, Panchanathan and Boyd, 2003]

Non-human animal examples:



Explanations for helpful behavior

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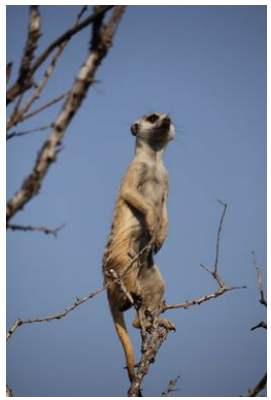
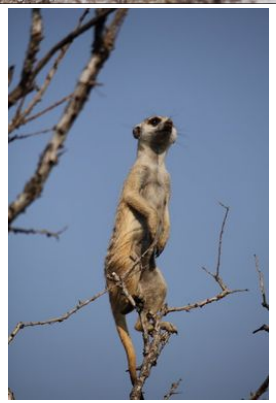
What explanation would you invoke for the following behavior?



Explanations for helpful behavior

Explanations seen up until now:

Kin altruism: $-C_i$, $+B_o$ ($rB_o > C_i$)



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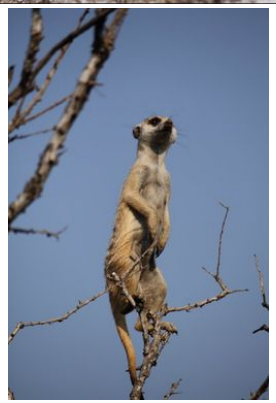

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- We help unrelated individuals
- Including strangers we will likely never meet again
- We take into account mistakes and/or attenuating circumstances
- We don't value efficiency [Burum et al., 2020]
- We do not keep track of favours with certain partners [Hoffman et al., 2015]
- We sometimes obscure our good deeds [Hoffman et al., 2018]
- We value and trust others more when they appear uncalculating, most or uninterested in material gains
- We don't simply trust based on behavior in a similar game, or reciprocate help with help, but instead make a wide-series of cross-inferences, and hold a "general" reputation

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Next session: signaling. NB: Actually Tit for Tat is not an ESS!

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