



COOPERATION: HOW TO MODEL IT, HOW TO FOSTER IT, AND HOW IT MIGHT HAVE EMERGED

# COOPERATION IN THE FIELD

Adrian Haret

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November 2, 2023

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A breakdown of what we'll be  
focusing on.

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# The Story of Cooperation



Cooperation is everywhere among living things.

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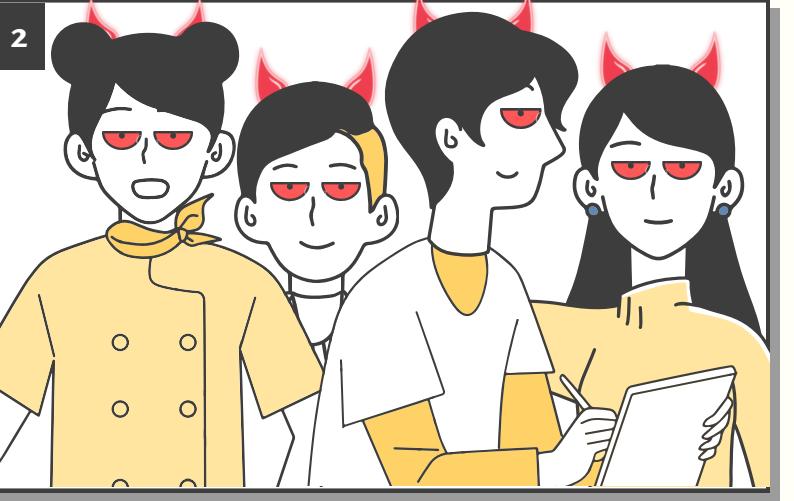


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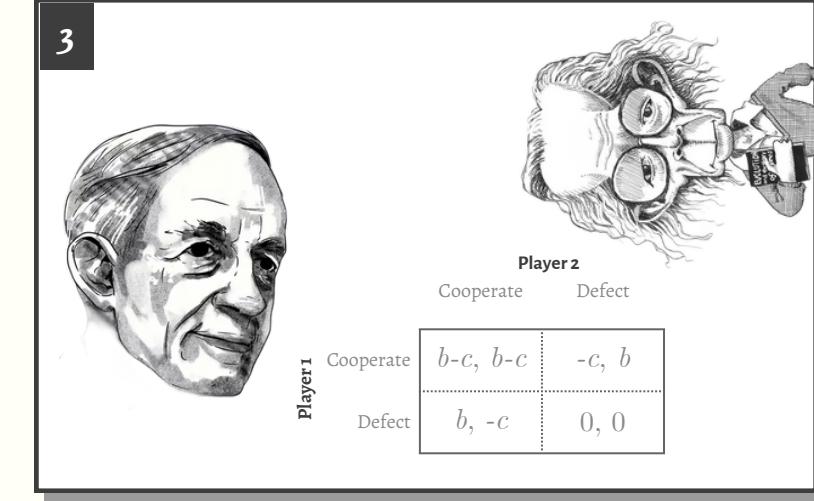
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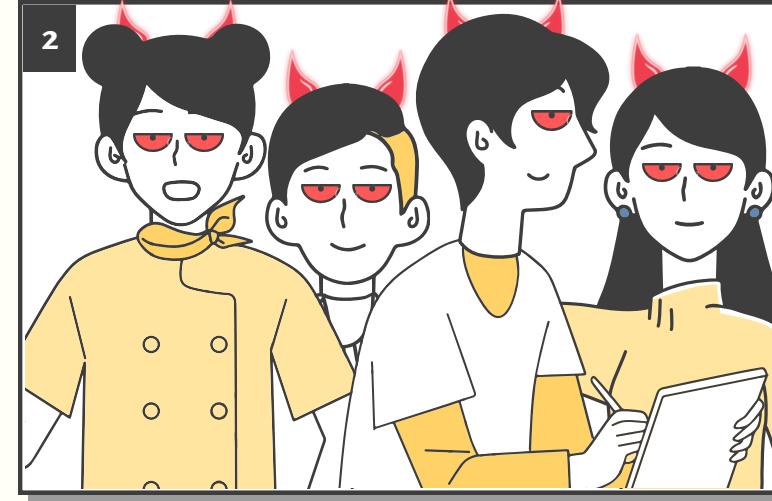


Game theory is the perfect tool to study the puzzle of cooperation.

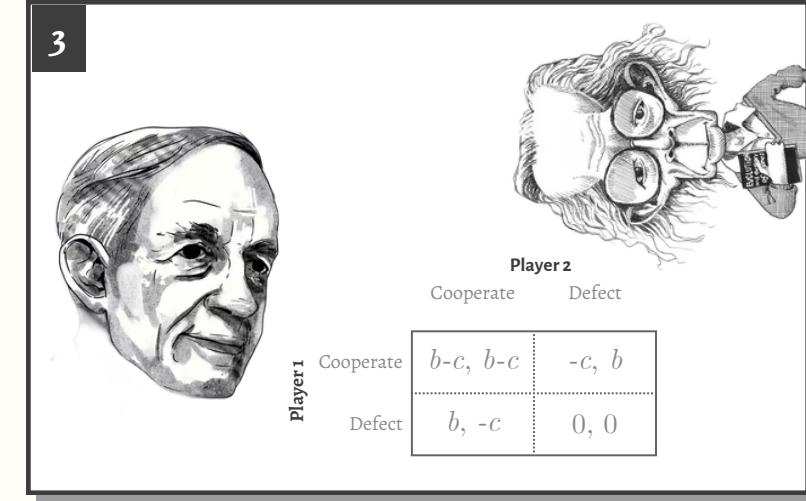
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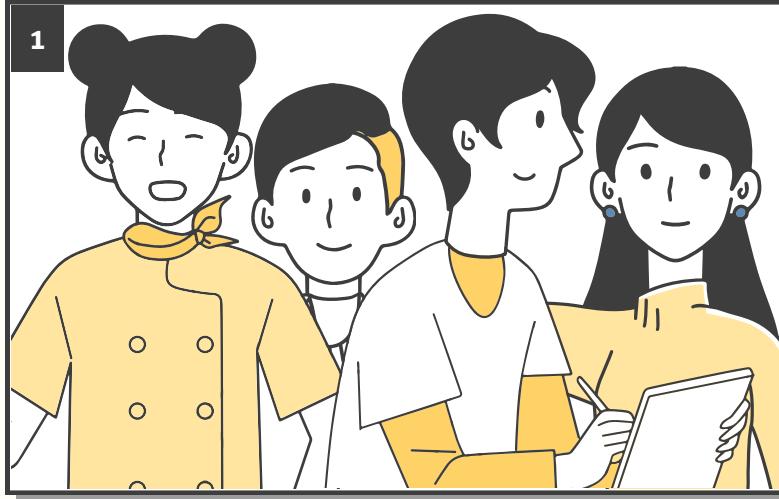


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We'll look for plausible mechanisms capable of ensuring cooperation in a world of selfish individuals.

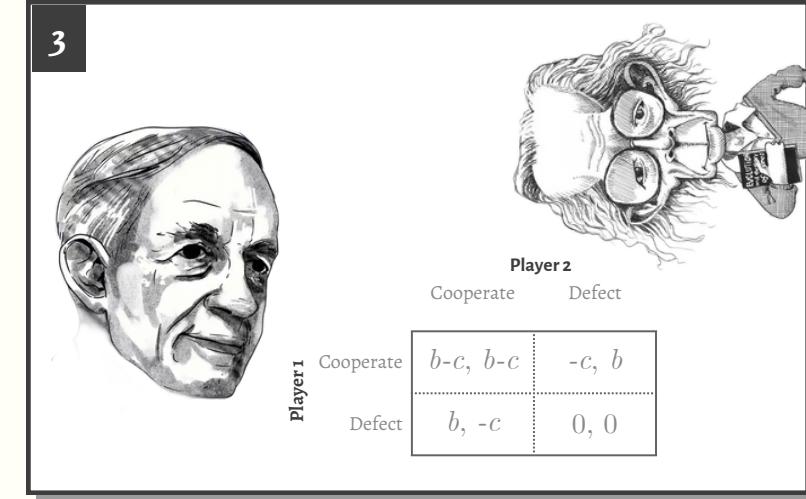
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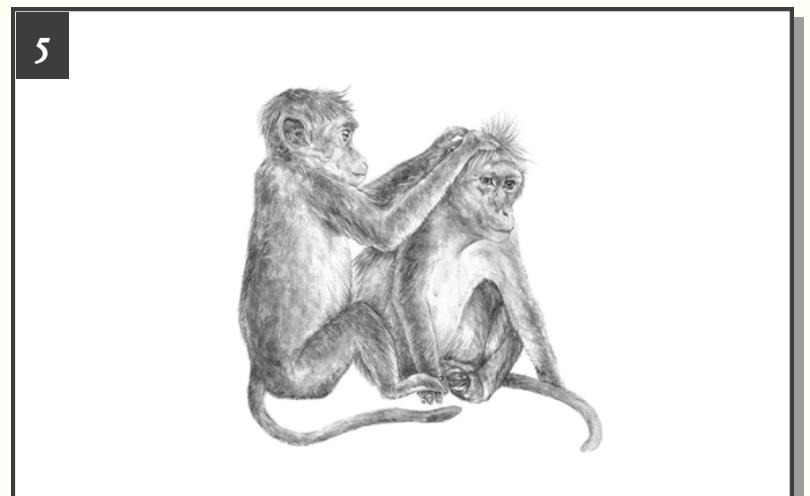
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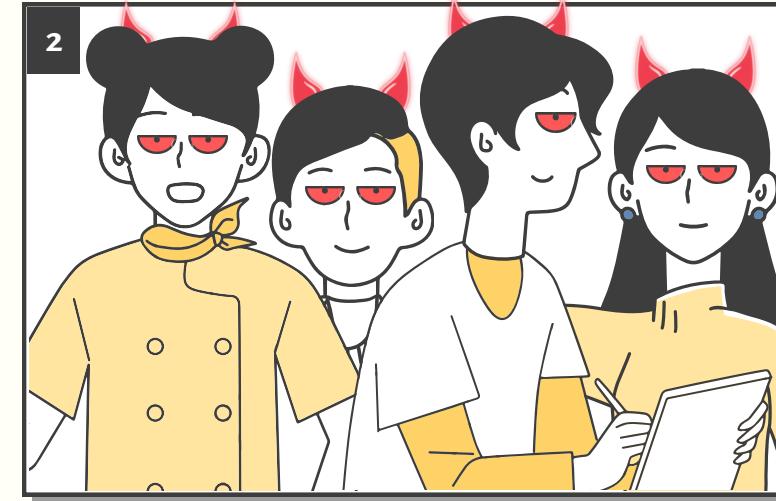


Such as reciprocity...

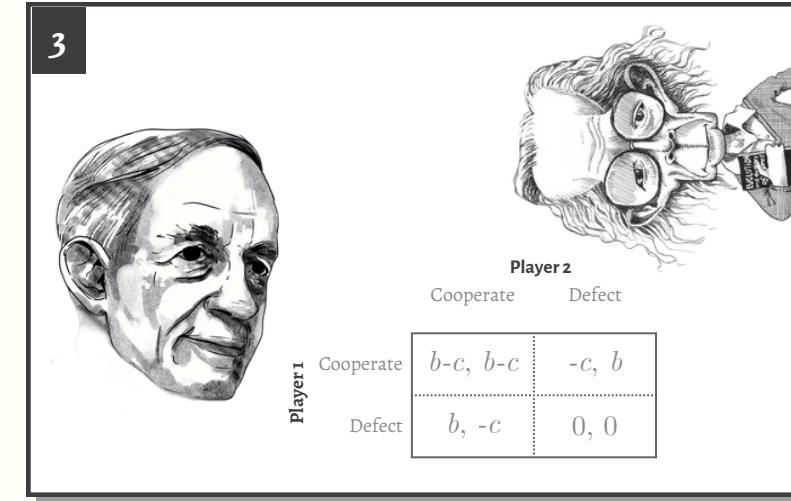
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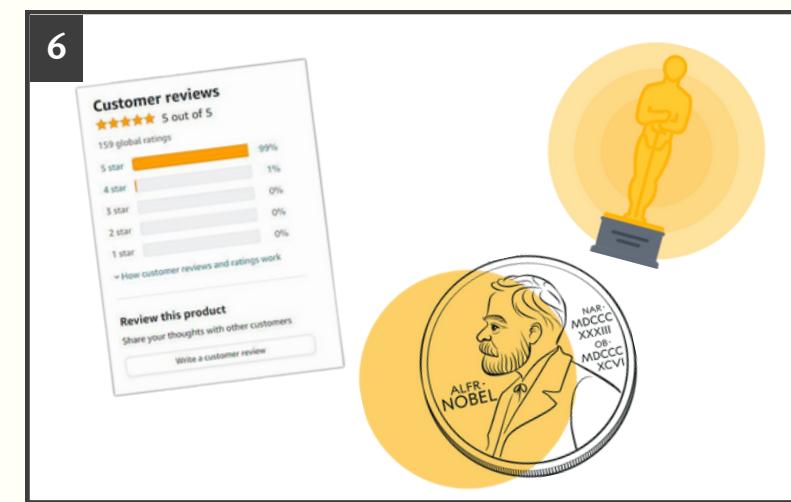
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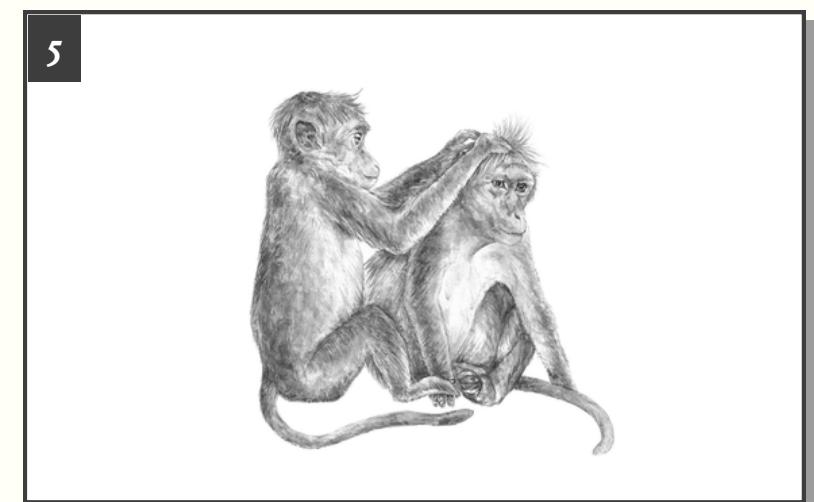
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trust and reputation...

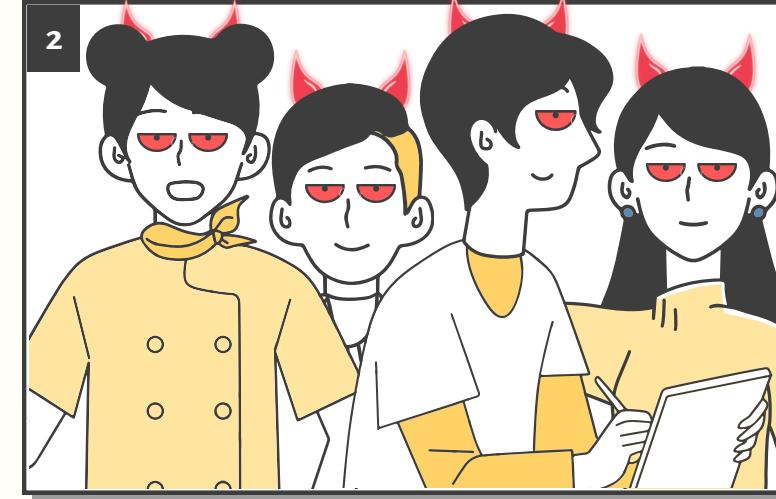


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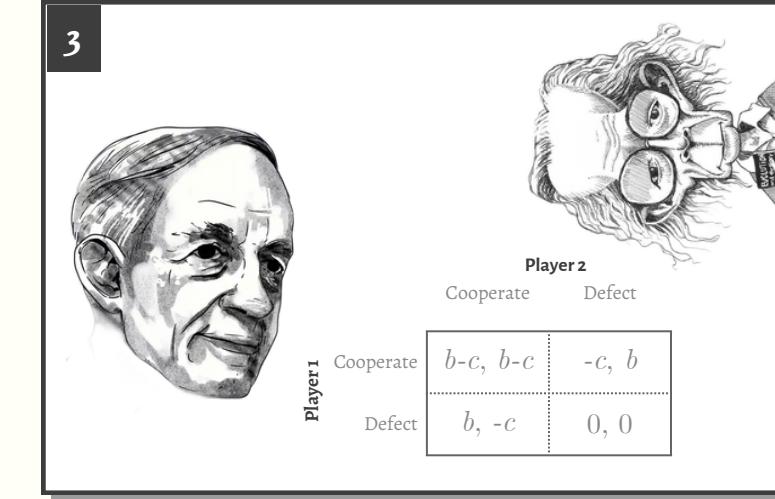
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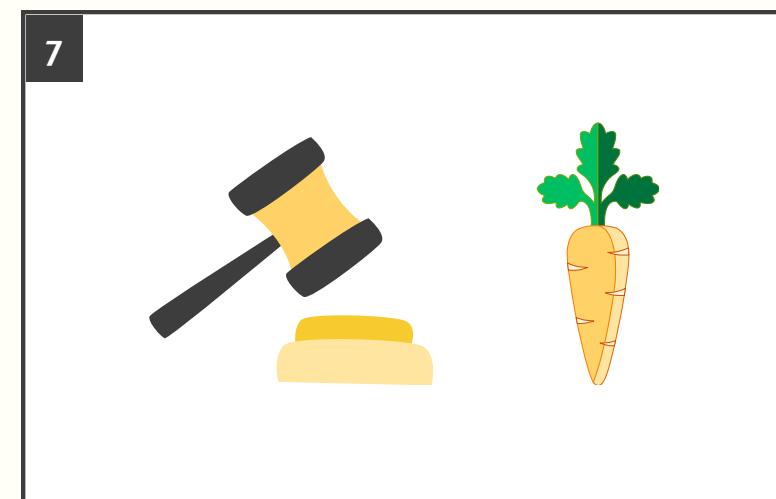
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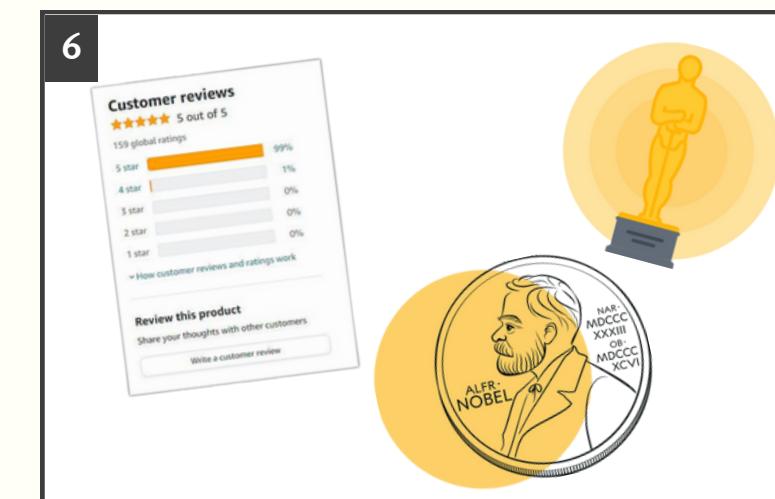
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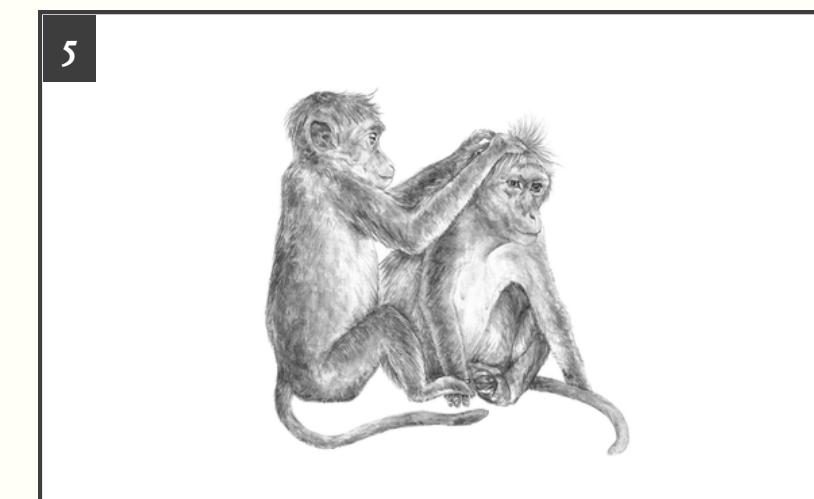
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trust and reputation...



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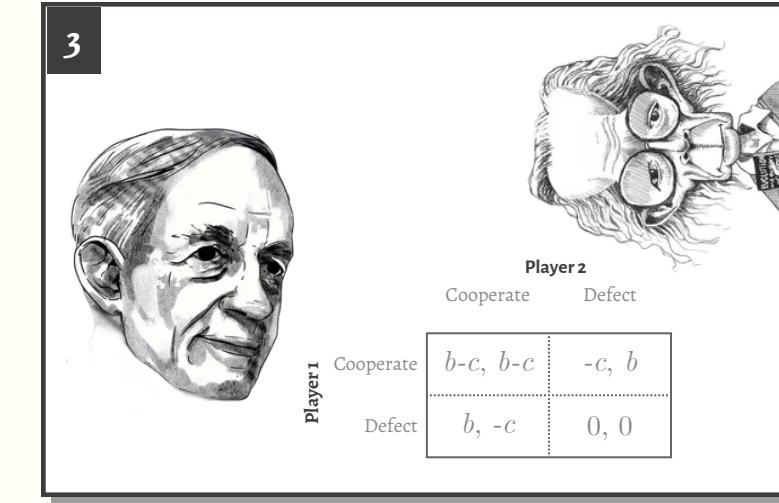
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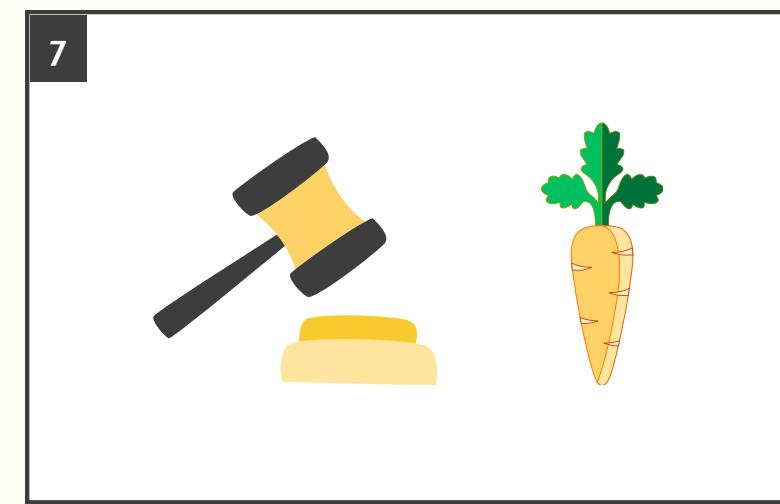
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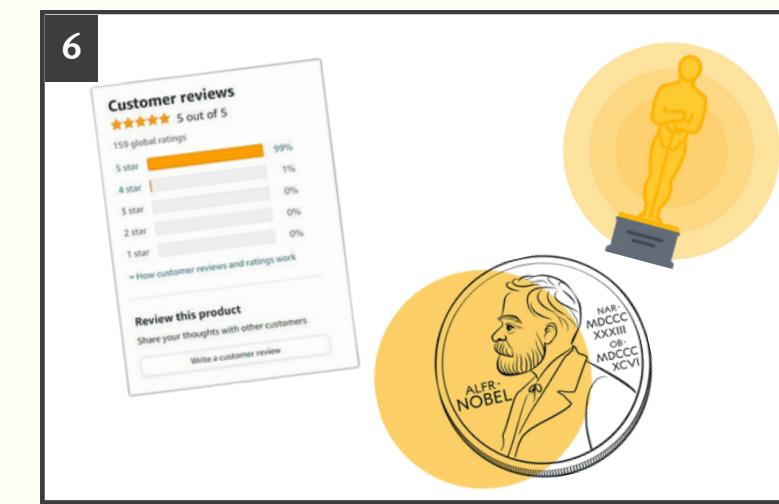
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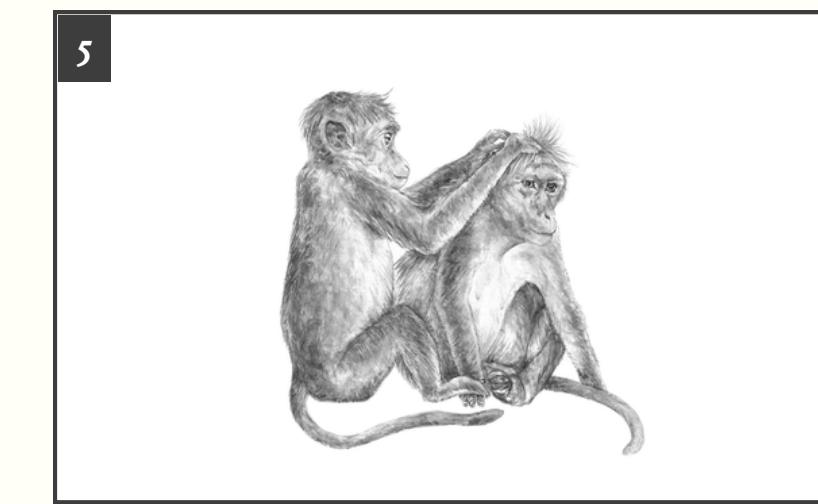
or selection based on kinship and group membership.



punishments and rewards...



trust and reputation...



Such as reciprocity...

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Where does cooperation occur?

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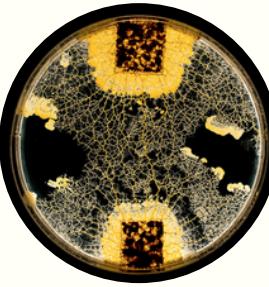
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Where does cooperation occur?  
Let's see some examples.



**SLIME MOLDS**

SLIME MOLD ELDER  
Slime molds are single-celled organisms, amoebas living in the  
ground.



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Kin, K., & Schaap, P. (2021). Evolution of Multicellular Complexity in The Dictyostelid Social Amoebas. *Genes*, 12(4).

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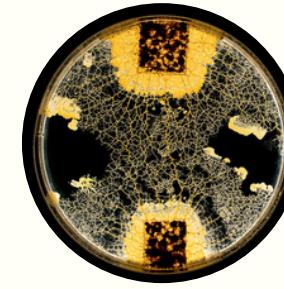
The fruiting body contains spores that end up producing other slime mold cells.

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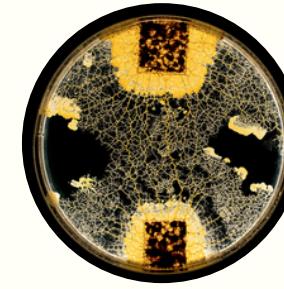
Meanwhile the cells in the stalk die, having ‘sacrificed’ themselves.

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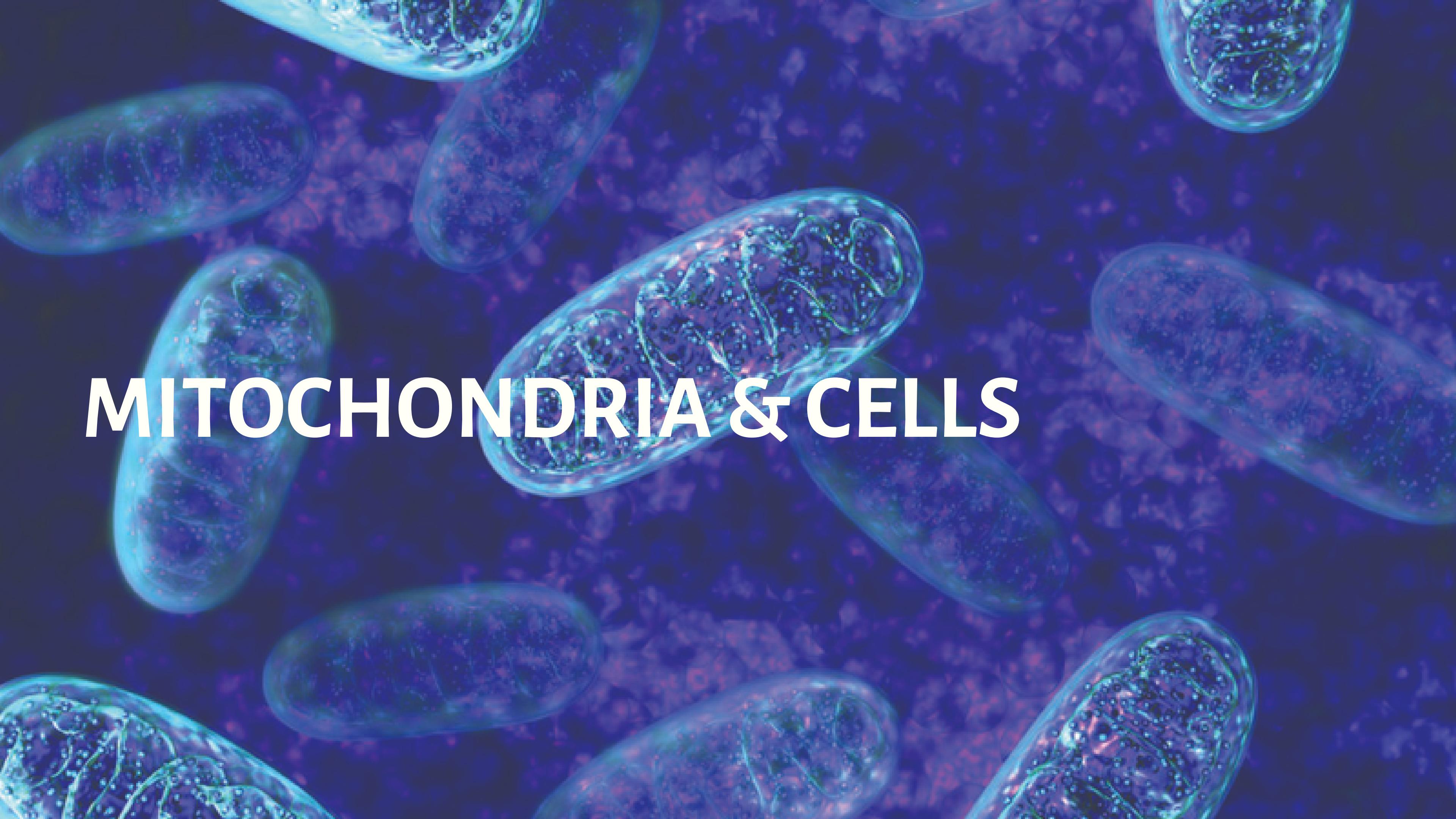
*why would they do that?*



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# MITOCHONDRIA & CELLS



## MITOCHONDRIA ELDER

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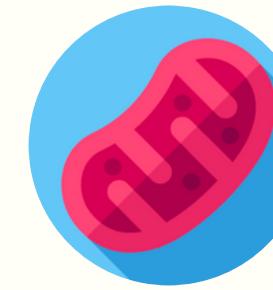
Hummert, S., Bohl, K., Basanta, D., Deutsch, A., Werner, S., Theissen, G., Schroeter, A., & Schuster, S. (2014). Evolutionary game theory: cells as players. *Molecular bioSystems*, 10(12), 3044–3065.

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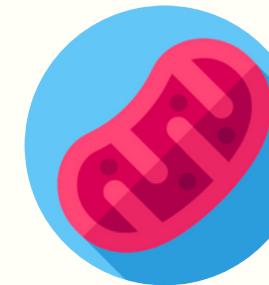
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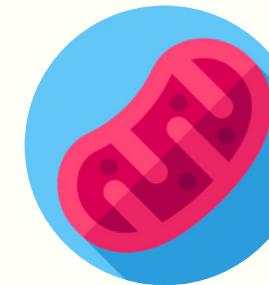
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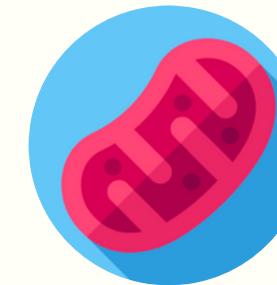
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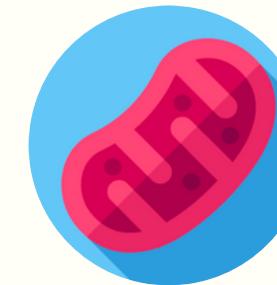
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LYNN MARGULIS

The details of this process are still subject to much debate.



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# LEAFCUTTER ANTS



E. O. WILSON

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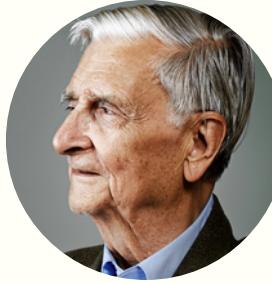


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how does such specialization arise?



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# VAMPIRE BATS



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We live in crowded caves, but need to go out every night to  
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# MEERKATS



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mmm scorpions... 😊

Griffin, A. S., Pemberton, J. M., Brotherton, P. N. M., McIlrath, G., Gaynor, D., Kansky, R., & Clutton-Brock, T. H. (2003). A genetic analysis of breeding success in the cooperative meerkat (*Suricata suricatta*). *Behavioral Ecology*, 14(4), 472–480.

MEERKAT ELDER

It is a truth widely acknowledged that in every group there must be a dominant male and female.



Dominants do most of the breeding: about 90% of the pups are born to the dominant female.

By the natural ordering of things, subordinates help the dominants raise their offspring.

why?!?

For instance, if a subordinate finds a scorpion, common sense dictates they will deliver it to the children of the dominants.



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A collage of black silhouettes of people against a bright yellow background. The silhouettes are arranged in a loose cluster, showing various poses such as walking, standing, and sitting. The background has a warm, glowing quality with some faint, illegible text or symbols.

PEOPLE

GEORGE FREDERIC WATTS

People sometimes engage in amazing acts of altruism.



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You can see a glimpse of this at the *Memorial of Heroic Self-Sacrifice* in Postman's Park, London.

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(that I set up)

AMELIA KENNEDY

AGED 19

DIED IN TRYING TO

SAVE HER SISTER  
FROM THEIR BVRNING HOVSE

IN EDWARD'S LANE STOKE  
NEWINGTON · OCT · 18 · 1871 ·



FREDERICK ALFRED CROFT

INSPECTOR · AGED 31

SAVED A LUNATIC WOMAN

FROM SUICIDE AT WOOLWICH  
ARSENAL STATION · BUT WAS  
HIMSELF RUN OVER BY THE TRAIN

JAN · 11 · 1878 ·

is there anything in it for them?  
does that even matter?



GEORGE FREDERIC WATTS  
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---

There are many example of humans being altruistic.

But these are anecdotes.

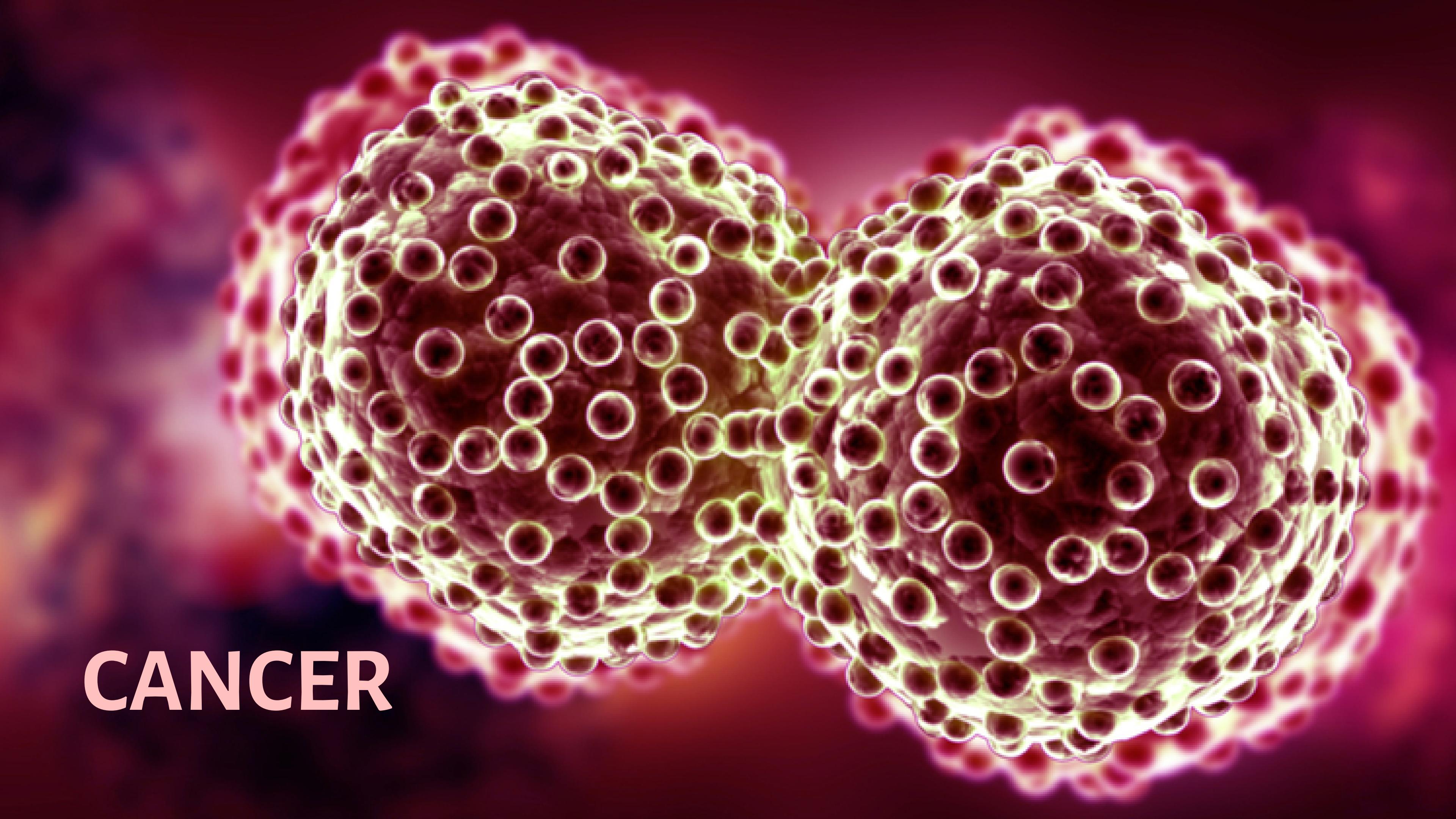
How altruistic are people *really*?



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Let's also look at some *failures* of cooperation.

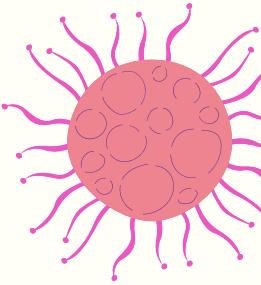
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CANCER

CANCER CELL ELDERS

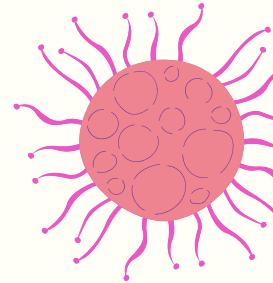
In a normally functioning organism, cells are cooperative:  
liver cells do liver stuff, skin cells do skin stuff.



Aktipis, C. A., Boddy, A. M., Jansen, G., Hibner, U., Hochberg, M. E., Maley, C. C., & Wilkinson, G. S. (2015). Cancer across the tree of life: cooperation and cheating in multicellularity. *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences*, 370(1673).9

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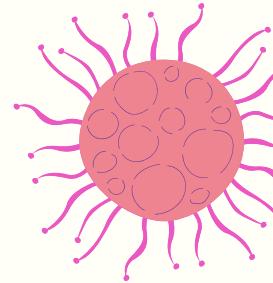


But sometimes, as result of mutation, cells go rogue and start multiplying uncontrolled, siphoning off resources from other cells.

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### CANCER CELL ELDERS

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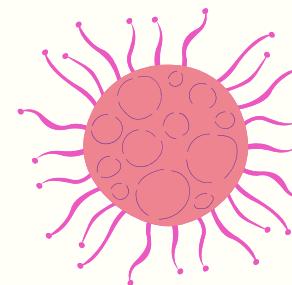


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Also known as cancer.

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what keeps 'normal' cells in check?

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**ANARCHIST BEES**

BEE ELDER  
With our distant cousins the ants, workers are usually  
sterile.



- Oldroyd, B. P., Smolenski, A. J., Cornuet, J.-M., & Crozler, R. H. (1994). Anarchy in the beehive. *Nature*, 371(6500), 749–749.
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But worker bees *can* lay eggs—just that normally they leave this task to the queen.

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ok, but why aren't all bees anarchists?



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CORRUPTION

---

“

Corruption is an abuse of  
entrusted power for private gain.

Transparency International. *Long Methodological Brief*, p.2.

---

DON CORLEONE

The way I like to think about it is, you take things from this  
big pot lying around, and you put it into the pockets of your  
family.



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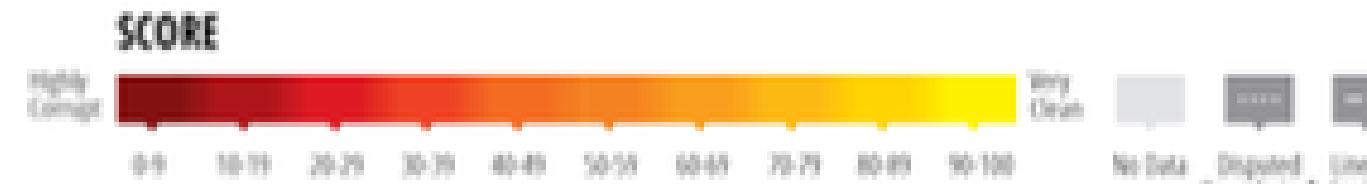


*aren't we all supposed to look  
after our families?*

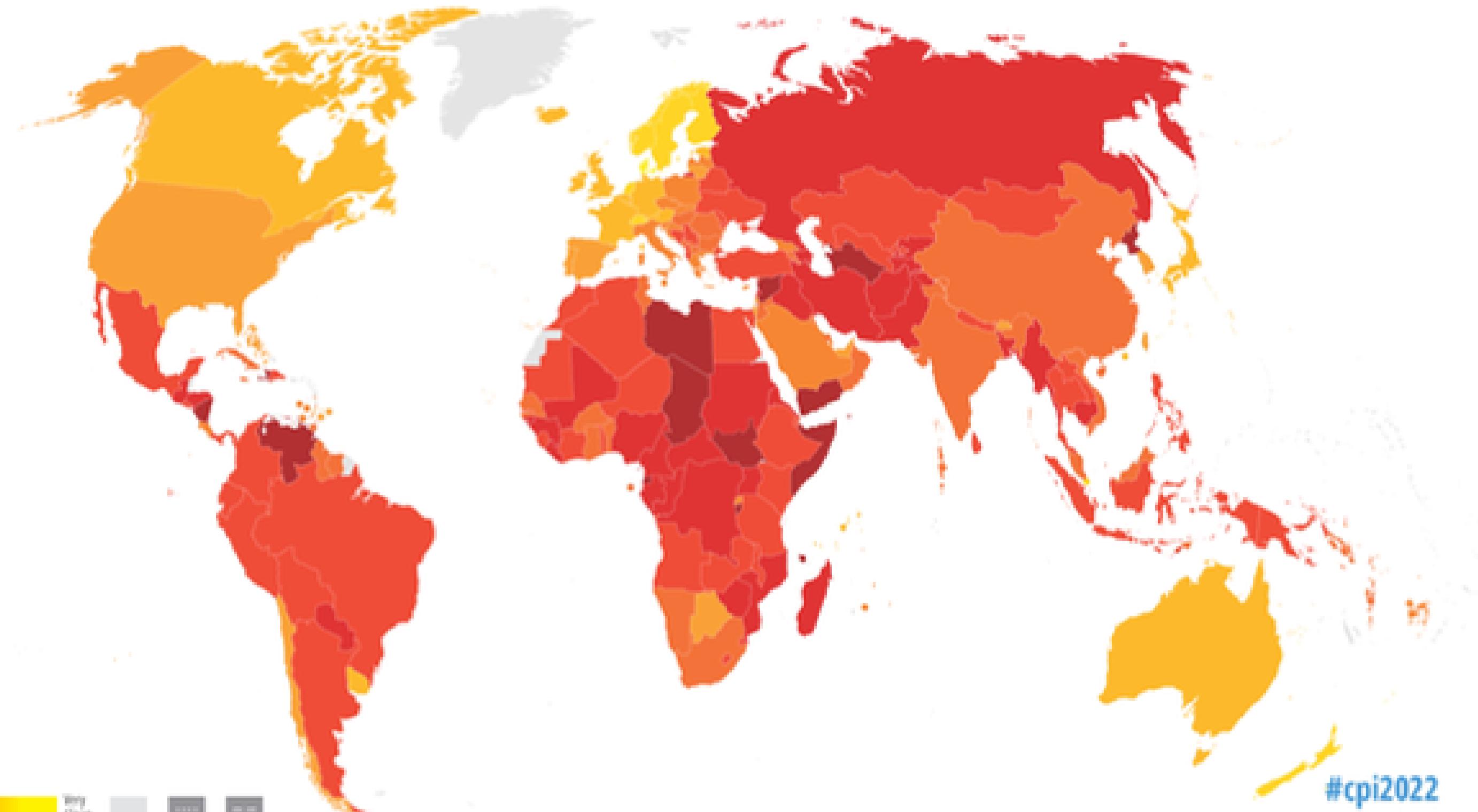


# CORRUPTION PERCEPTIONS INDEX 2022

The perceived levels of public sector corruption in 180 countries/territories around the world.



The designations employed and the presentation of material on this map follow the UN practice to the best of our knowledge and as of January 2022. They do not imply the expression of any opinion on the part of Transparency International concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.



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#cpi2022

[www.transparency.org/cpi](http://www.transparency.org/cpi)

Notice anything about this map?

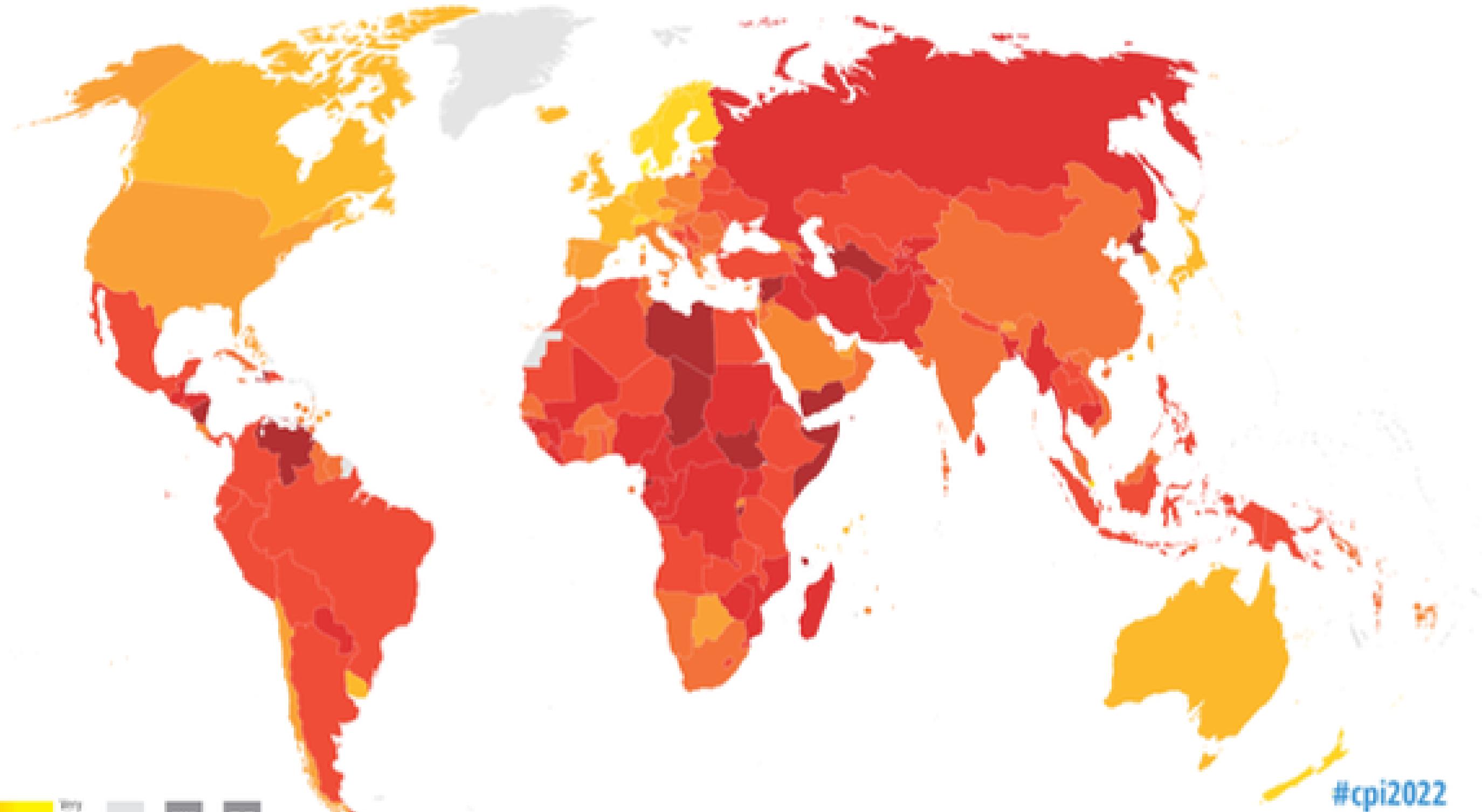


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JOE HENRICH

Most of the least corrupt countries seem to be WEIRD...

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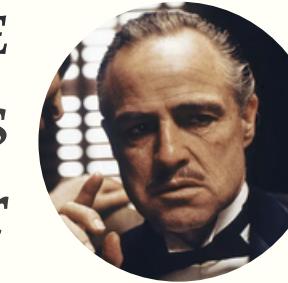
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WEIRD  
Western, Educated, Industrialized,  
Rich, Democratic

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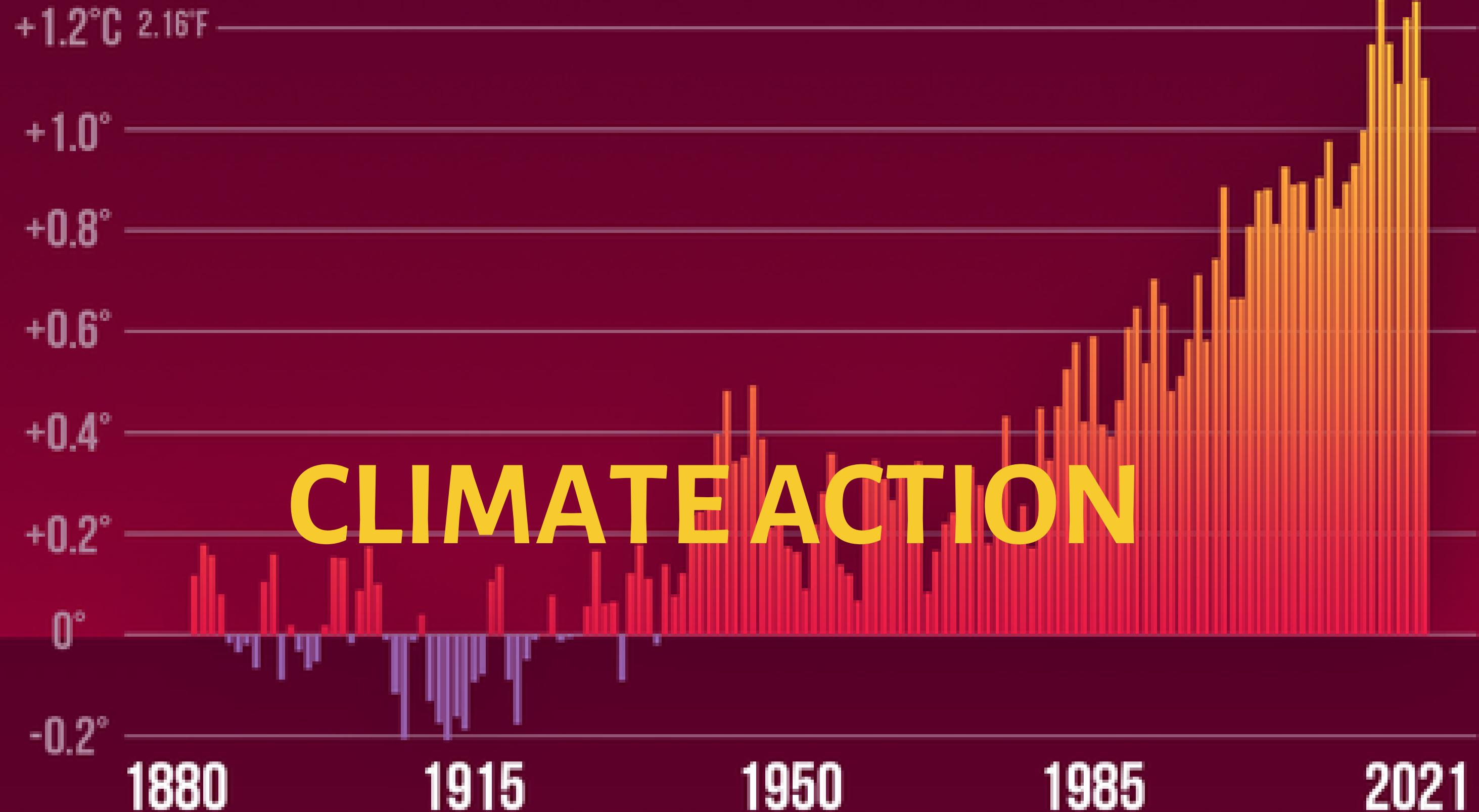
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Coincidence?

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Source: NASA GISS & NOAA NCEI global temperature anomalies averaged and adjusted to early industrial baseline (1881-1910). Data as of 1/13/2022.

CLIMATE CO<sub>2</sub> CENTRAL

# Cyclone Freddy

In 2023, around 500,000 people were estimated to have been affected by floods, mudslides and wind damage following the passage of Tropical Cyclone Freddy in southern Malawi.



JOSEPH STIGLITZ

Poor countries should be provided with \$300bn a year from  
the International Monetary Fund to finance their fight  
against the climate crisis.



Elliott, L. (2023, October 13). [IMF should give poor countries \\$300bn a year to fight climate crisis, says Joseph Stiglitz. The Guardian.](#)

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why wouldn't the US want to help  
poorer countries?

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A cell, a worker bee, a person, a US  
congressman: why should they  
cooperate with others?

---

---

Wait a minute. So what exactly do we mean by cooperation?

---

## **DEFINITION (PRELIMINARY)**

A behavior is *cooperative* if it provides a benefit to another party, at a cost.

## DEFINITION (PRELIMINARY)

- 1 A behavior is *cooperative* if it provides a benefit to another party, at a cost.

*does not include situations where  
both parties are immediately  
better off (e.g., trade).*

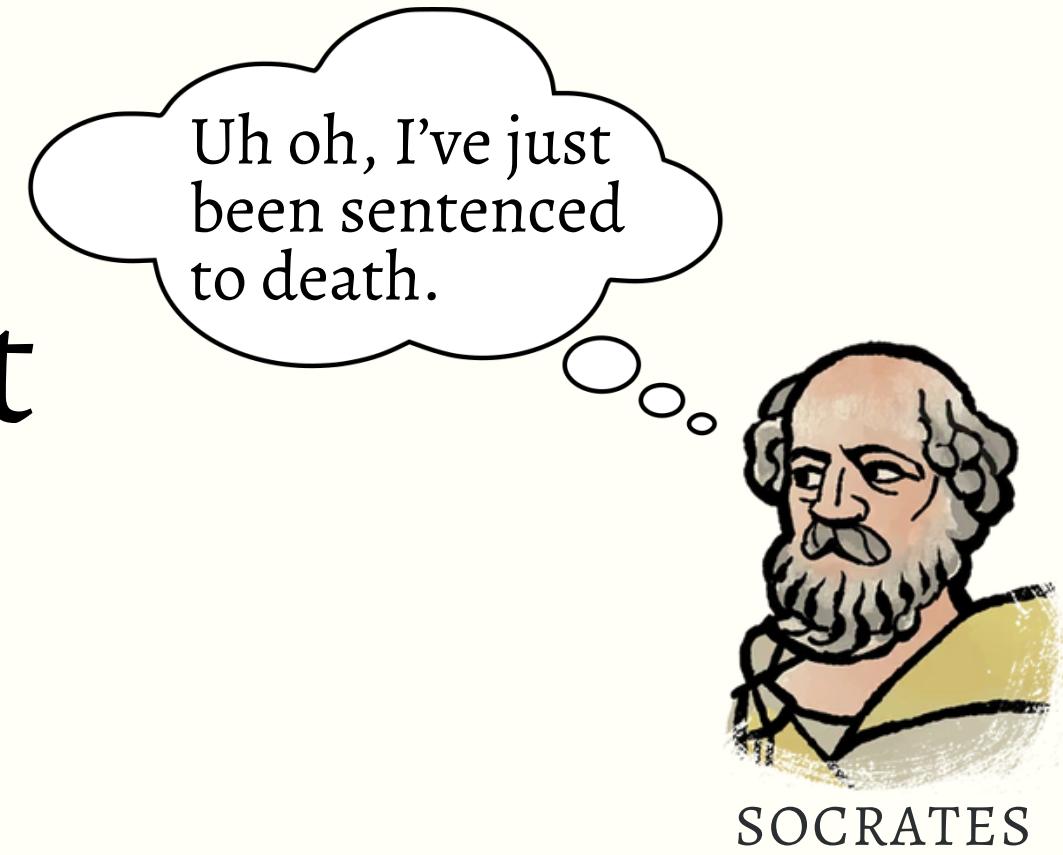
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There should be a cost to  
cooperation... and there's the rub.

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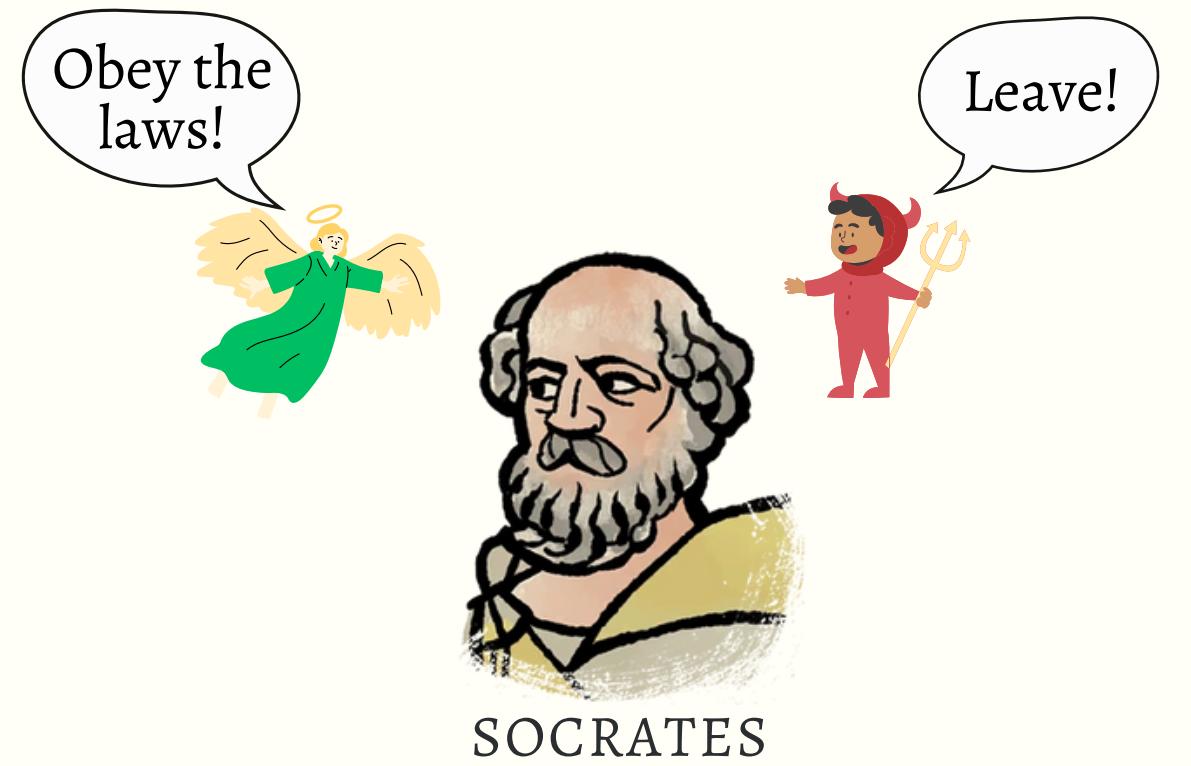
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Cooperation: the age-old  
conflict between self-interest  
vs (some version of) the  
common good.



---

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---

We can make this drama more  
precise.

---

---

We can make this drama more  
precise.

With a little detour through...

---

GAME  
THEORY