



STRATEGIC MINDS: THE GAME THEORY OF COOPERATION, COORDINATION AND COLLABORATION

THE PROBLEM OF COOPERATION

.....

CAN IT PAY OFF TO FORGO A PAYOFF?

Adrian Haret
a.haret@lmu.de

April 15, 2024

We call a behavior *cooperative* if it provides a benefit to another party, at a cost.

We call a behavior **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).

We call a behavior **cooperative** if it provides a benefit to another party, at a cost.

Sometimes also called *altruism*.

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

We call a behavior **cooperative** if it provides a benefit to another party, at a cost.

Sometimes also called *altruism*.

Though it need not involve conscious action...

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

Why is this a *problem*?

It's not clear if cooperation can survive in a world of self-interested individuals.

The Story of Cooperation

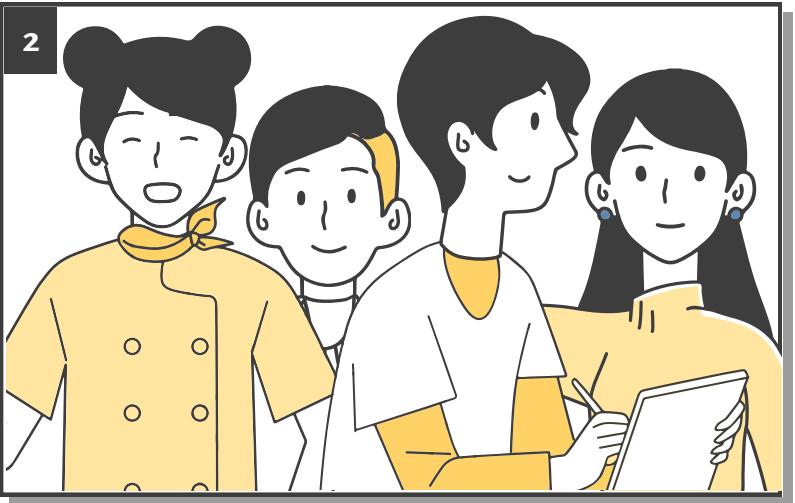


Cooperation is everywhere among living things.

The Story of Cooperation



Cooperation is everywhere among living things.

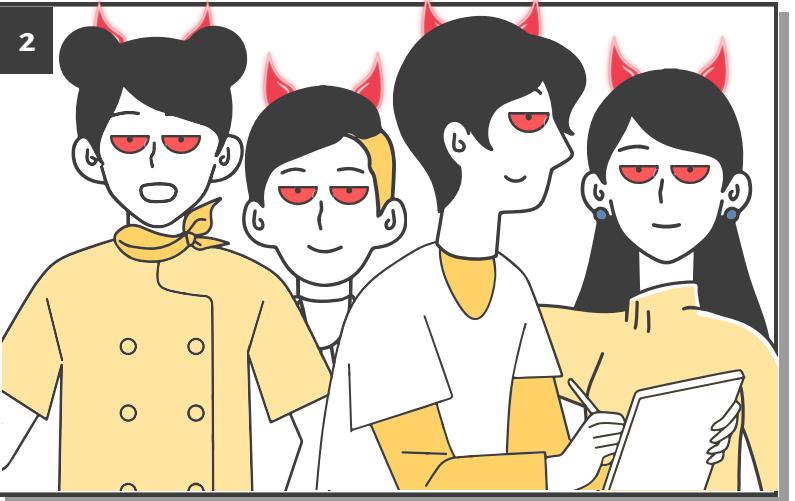


But how, when everyone is in it only for themselves?

The Story of Cooperation



Cooperation is everywhere among living things.



But how, when everyone is in it only for themselves?

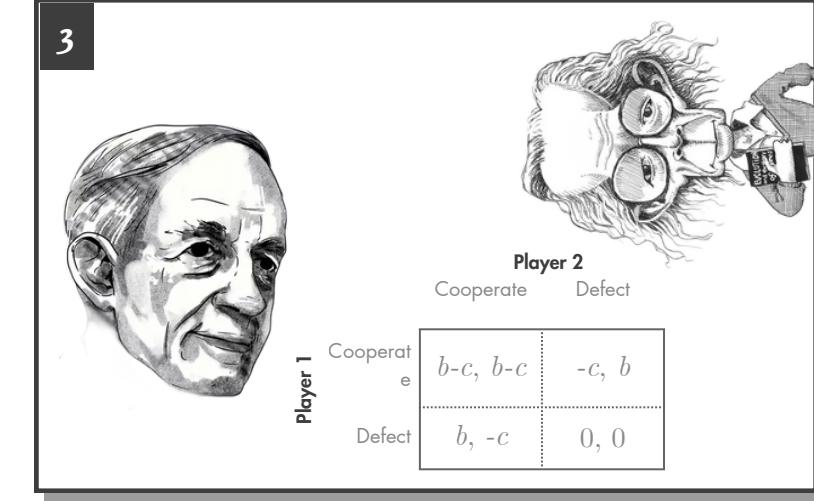
The Story of Cooperation



Cooperation is everywhere among living things.



But how, when everyone is in it only for themselves?

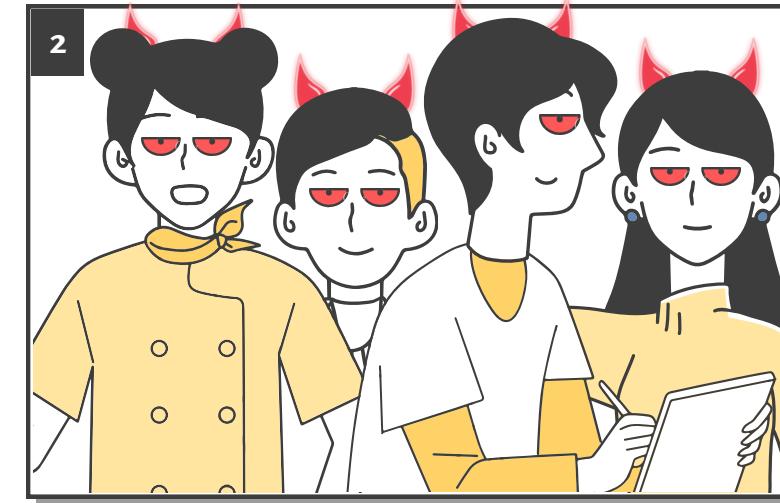


Game theory is the perfect tool to study the puzzle of cooperation.

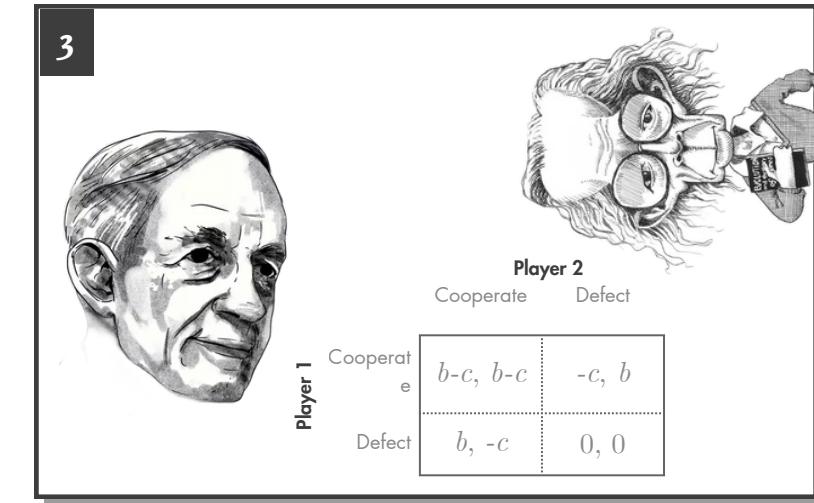
The Story of Cooperation



Cooperation is everywhere among living things.



But how, when everyone is in it only for themselves?



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



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

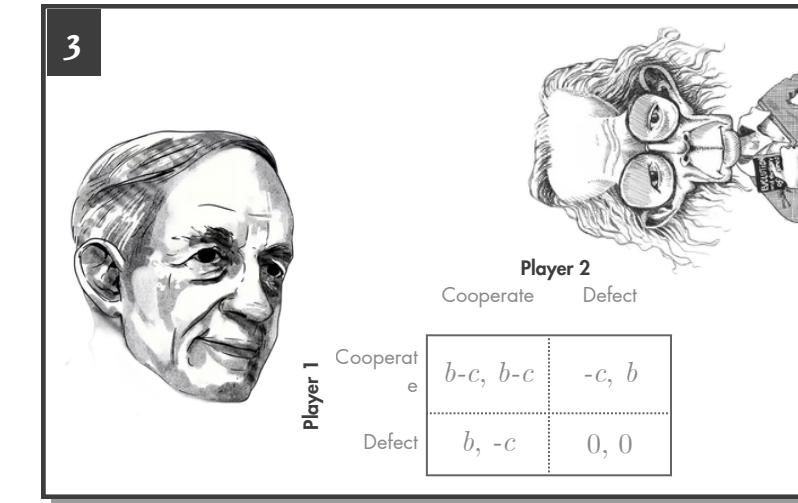
The Story of Cooperation



Cooperation is everywhere among living things.



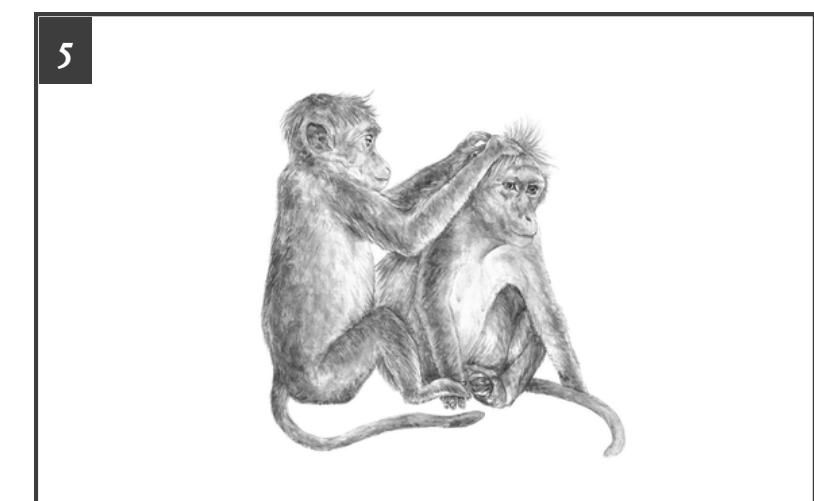
But how, when everyone is in it only for themselves?



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



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

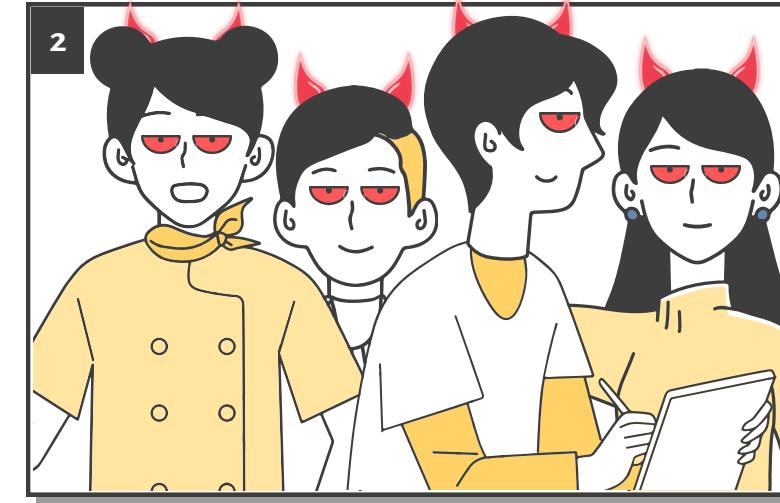


Such as reciprocity...

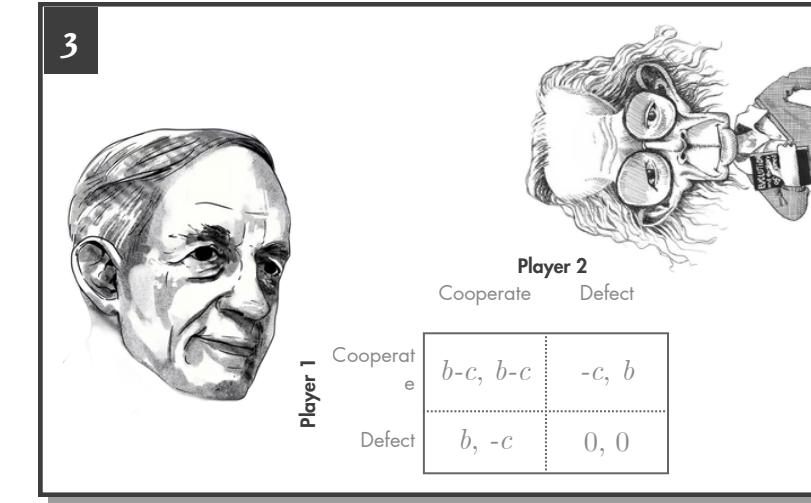
The Story of Cooperation



Cooperation is everywhere among living things.



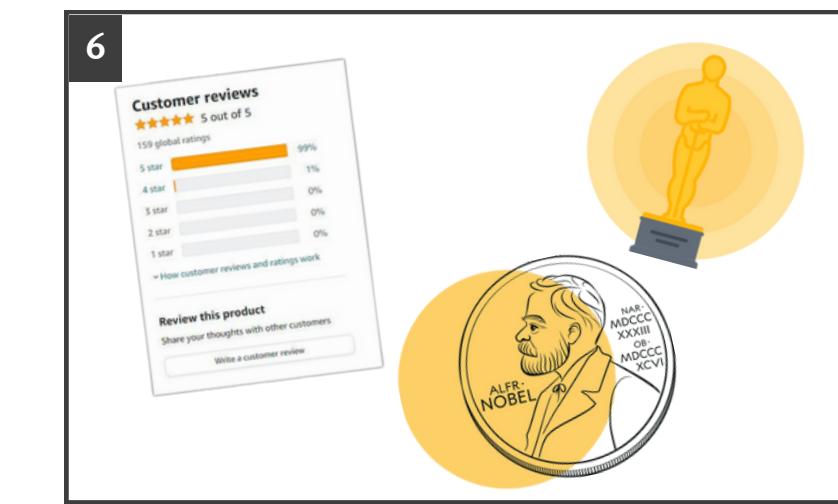
But how, when everyone is in it only for themselves?



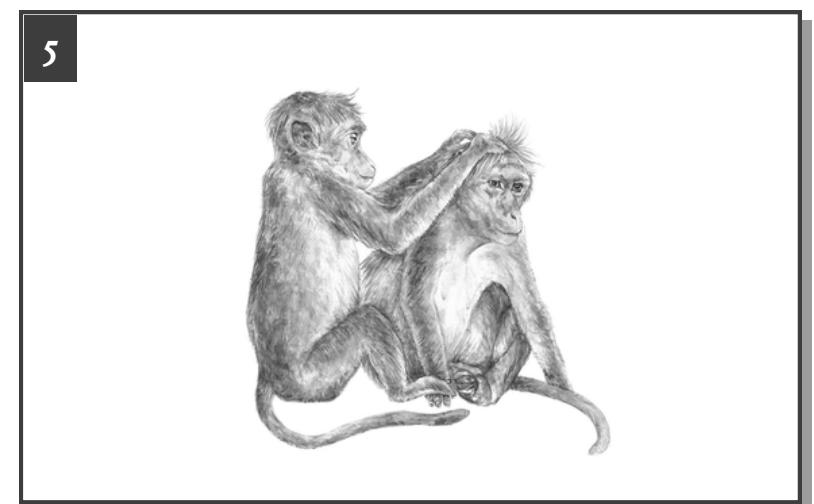
Game theory is the perfect tool to study the puzzle of cooperation.



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



trust and reputation...



Such as reciprocity...

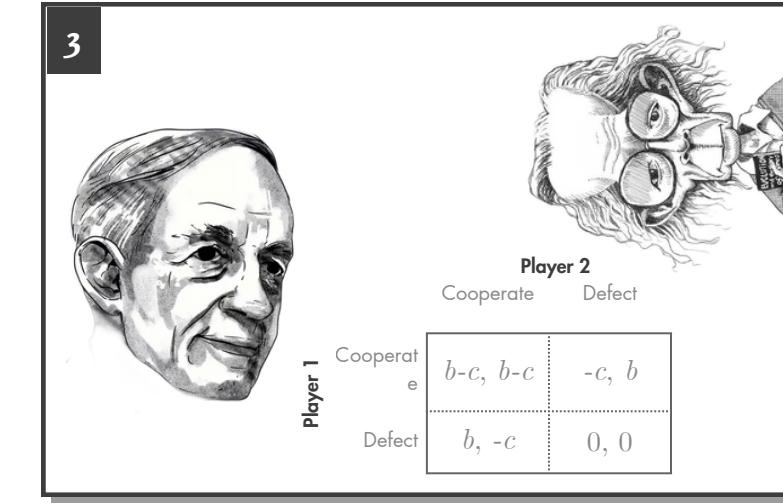
The Story of Cooperation



Cooperation is everywhere among living things.



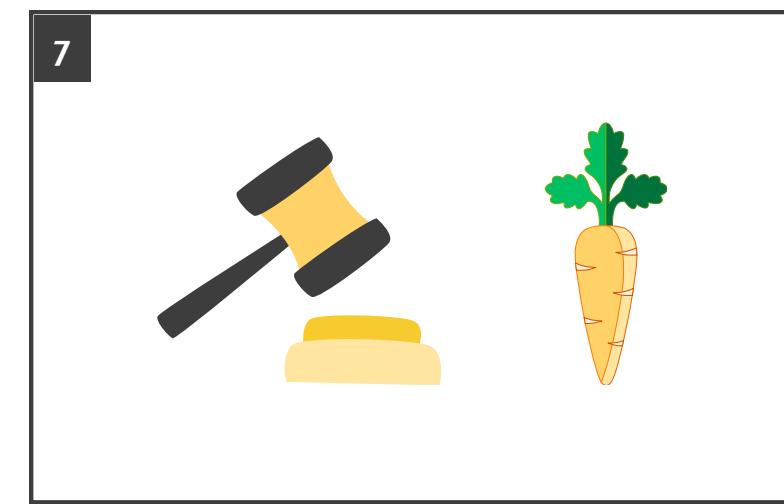
But how, when everyone is in it only for themselves?



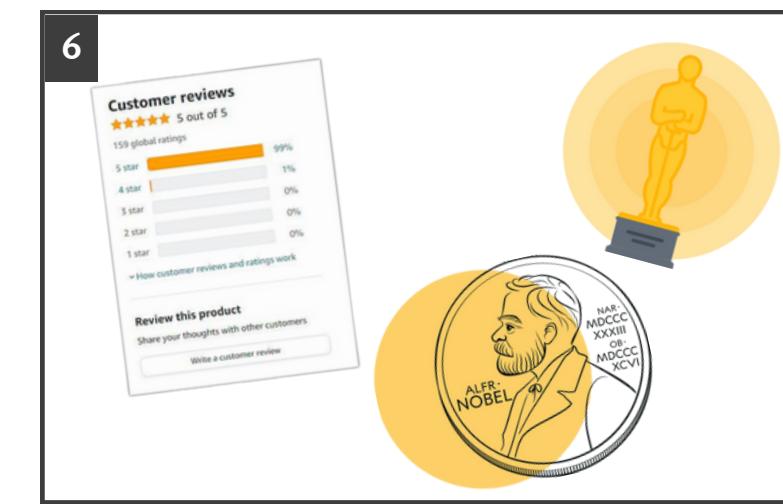
Game theory is the perfect tool to study the puzzle of cooperation.



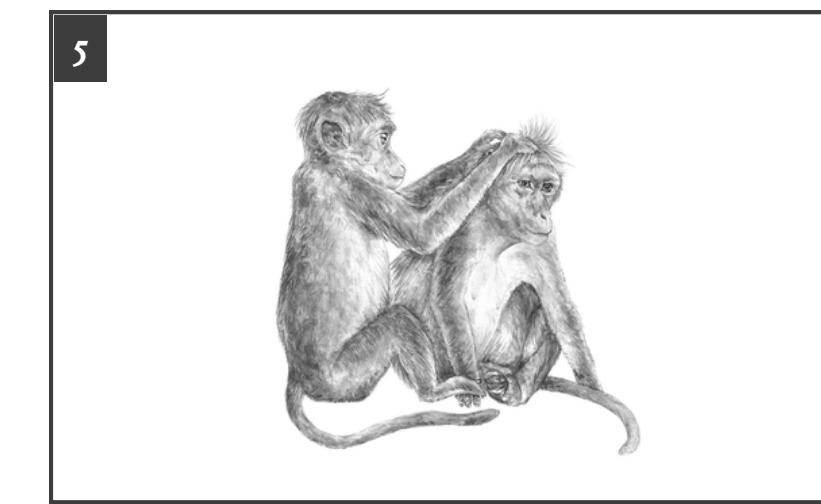
We'll look for plausible mechanisms capable of ensuring cooperation in a world of selfish individuals.



punishments and rewards...



trust and reputation...

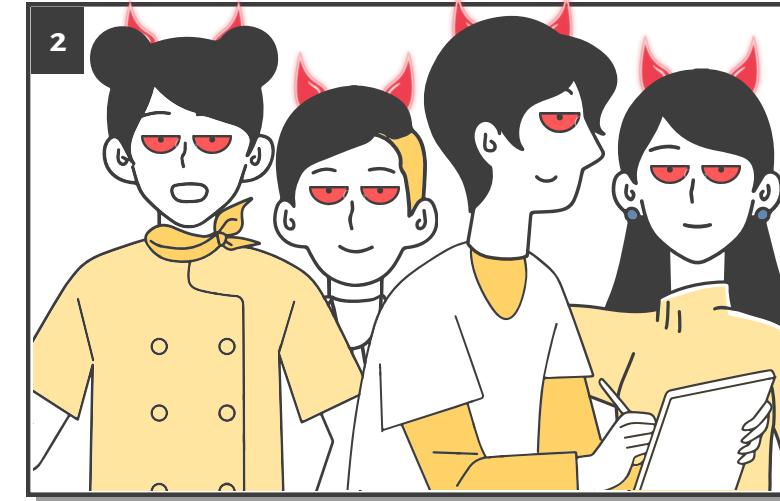


Such as reciprocity...

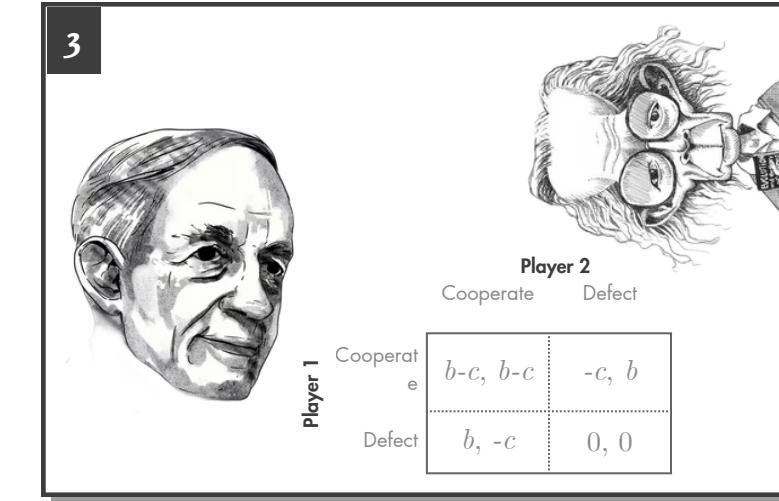
The Story of Cooperation



Cooperation is everywhere among living things.



But how, when everyone is in it only for themselves?



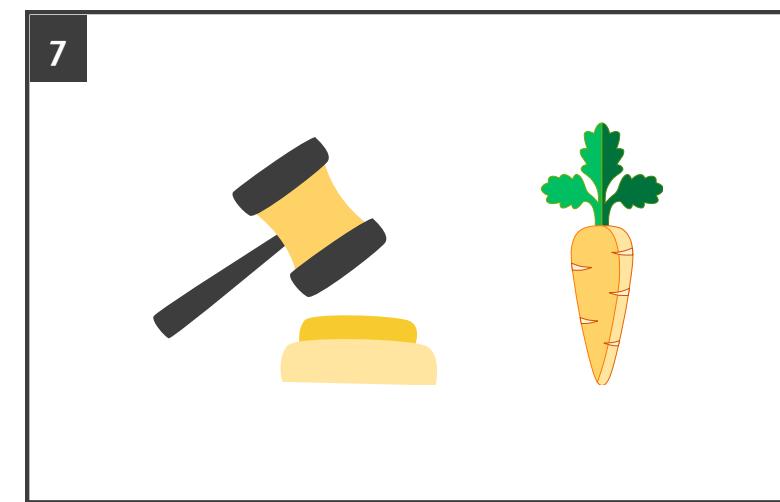
Game theory is the perfect tool to study the puzzle of cooperation.



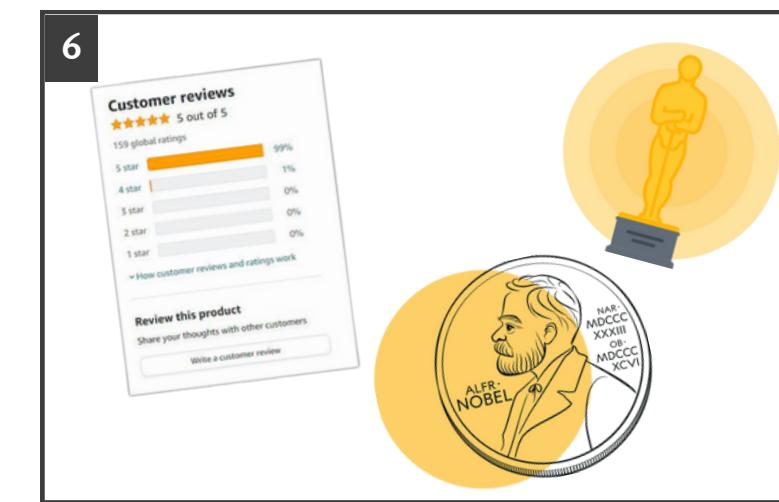
We'll look for plausible mechanisms capable of ensuring cooperation in a world of selfish individuals.



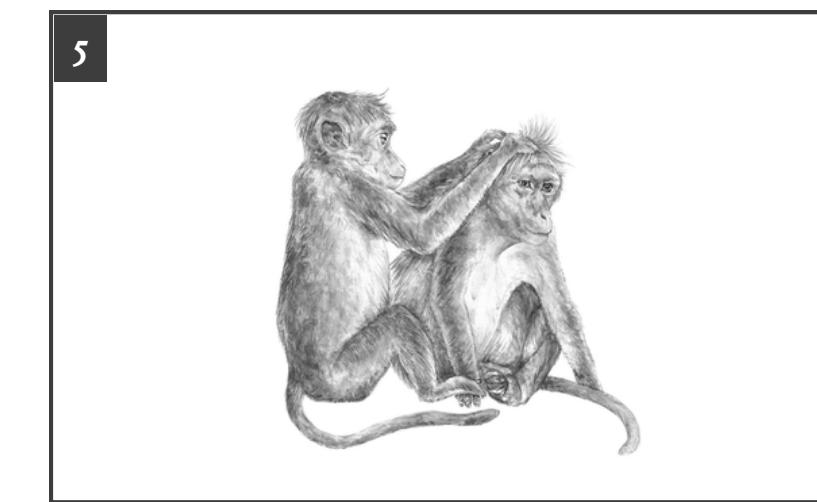
or selection based on kinship and group membership.



punishments and rewards...



trust and reputation...



Such as reciprocity...

Where does cooperation occur?

Where does cooperation occur?

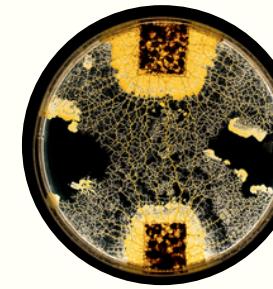
Let's see some examples.



SLIME MOLDS

SLIME MOLD ELDER

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



When resources are scarce, slime molds group together to form stalks with bulbs (fruiting bodies) at one end.

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

Meanwhile the cells in the stalk die, having 'sacrificed' themselves.

why would they do that?



Solman, P. (2012, April 5). [Slime Molds: No Brains, No Feet, No Problem](#). PBS NewsHour.

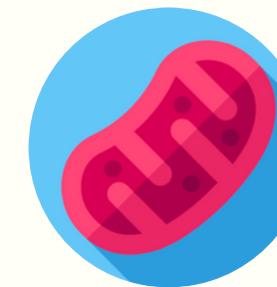
Kin, K., & Schaap, P. (2021). Evolution of Multicellular Complexity in The Dictyostelid Social Amoebas. *Genes*, 12(4).

MITOCHONDRIA & CELLS



MITOCHONDRIA ELDER

Legend has it that about 1.8 billion years ago an early cell swallowed a bacterium—but instead of digesting it, it kept the bacterium around inside its body.



The bacterium went on living and reproducing inside its host cell.

This arrangement proved somehow useful, and managed to stay on, perpetuating itself.

what were the tradeoffs involved?

The two entities evolved into the eukaryotic cells with mitochondria that make up all y'all bodies to this day.



LYNN MARGULIS

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



Margulis, L. (1970). *Origin of Eukaryotic Cells*. Yale University Press.

Martin, W., Hoffmeister, M., Rotte, C., & Henze, K. (2001). An overview of endosymbiotic models for the origins of eukaryotes, their ATP-producing organelles (mitochondria and hydrogenosomes), and their heterotrophic lifestyle. *Biological Chemistry*, 382(11), 1521–1539.

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.

Lane, N. (2018). *Power, Sex, Suicide: Mitochondria and the Meaning of Life (Second Edition)*. Oxford University Press.

PBS Eons (2018). [How Two Microbes Changed History YouTube](#).

LEAFCUTTER ANTS



E. O. WILSON

Leafcutter ants have complex, highly organized societies.



With very defined roles: a (single) queen, males, workers.

And caste-based division of labor: some ants forage for food (leaf fragments), others handle the foraged food back at the nest.

Remarkably, leafcutter ants farm a special type of fungus, which they use as food.

how does such specialization arise?



Holldobler, B., & Wilson, E. O. (2010). *The Leafcutter Ants: Civilization by Instinct (Illustrated edition)*. Norton & Company.

VAMPIRE BATS



VAMPIRE BAT ELDER

We live in crowded caves, but need to go out every night to procure food. 

But sometimes we're unlucky, don't find any food, and return to the roost hungry.

If this happens three days in a row we starve.

Fortunately, luckier mates are willing to share food in case of need.



Wilkinson, G. S. (1984). Reciprocal food sharing in the vampire bat. *Nature*, 308(5955), 181–184.

Carter, G. G., Farine, D. R., Crisp, R. J., Vrtilek, J. K., Ripperger, S. P., & Page, R. A. (2020). Development of New Food-Sharing Relationships in Vampire Bats. *Current Biology*, 30(7), 1275–1279.

A photograph of three meerkats standing in a row, facing right. They are in a dry, brown landscape with some sparse vegetation. The meerkats have light brown fur with darker stripes. The text "MEERKATS" is overlaid in the bottom left corner.

MEERKATS



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.



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.

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, abstract shapes.

PEOPLE

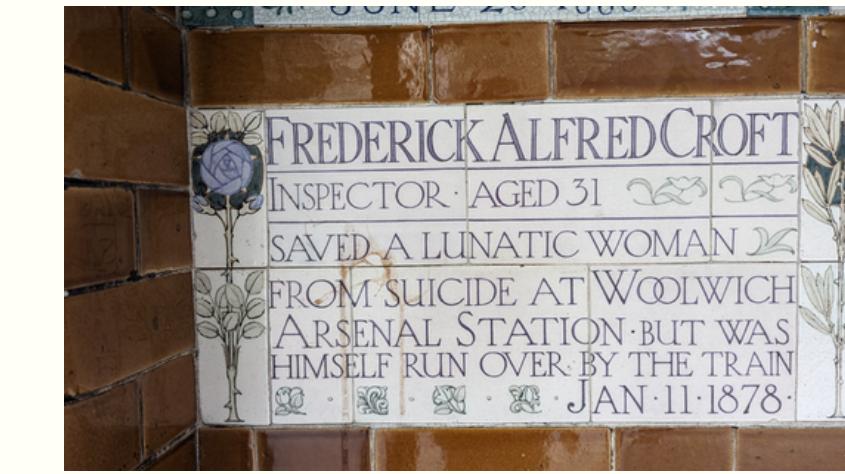
GEORGE FREDERIC WATTS
People sometimes engage in amazing acts of altruism.



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

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

(that I set up)



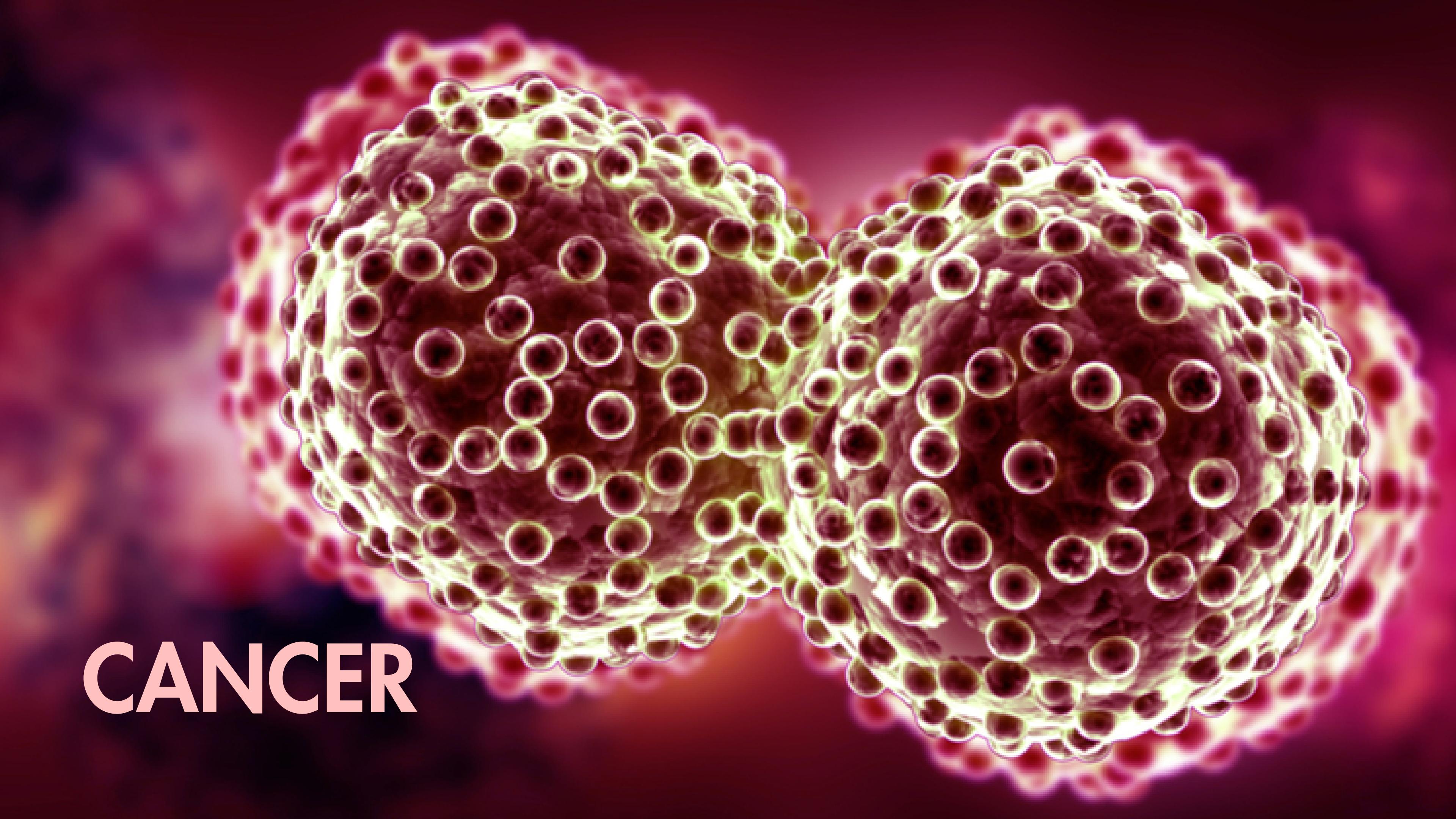
There are many example of humans being altruistic.

But these are anecdotes.

How altruistic are people *really*?

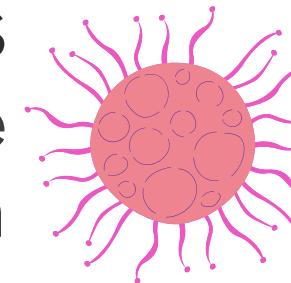


Let's also look at some *failures* of cooperation.



CANCER

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



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

Also known as cancer.

what keeps 'normal' cells in check?



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).



ANARCHIST BEES

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



But worker bees *can* lay eggs—just that normally they leave this task to the queen.

There is, however, a mutation that turns worker bees into anarchists that keep laying eggs (even when there is a queen).

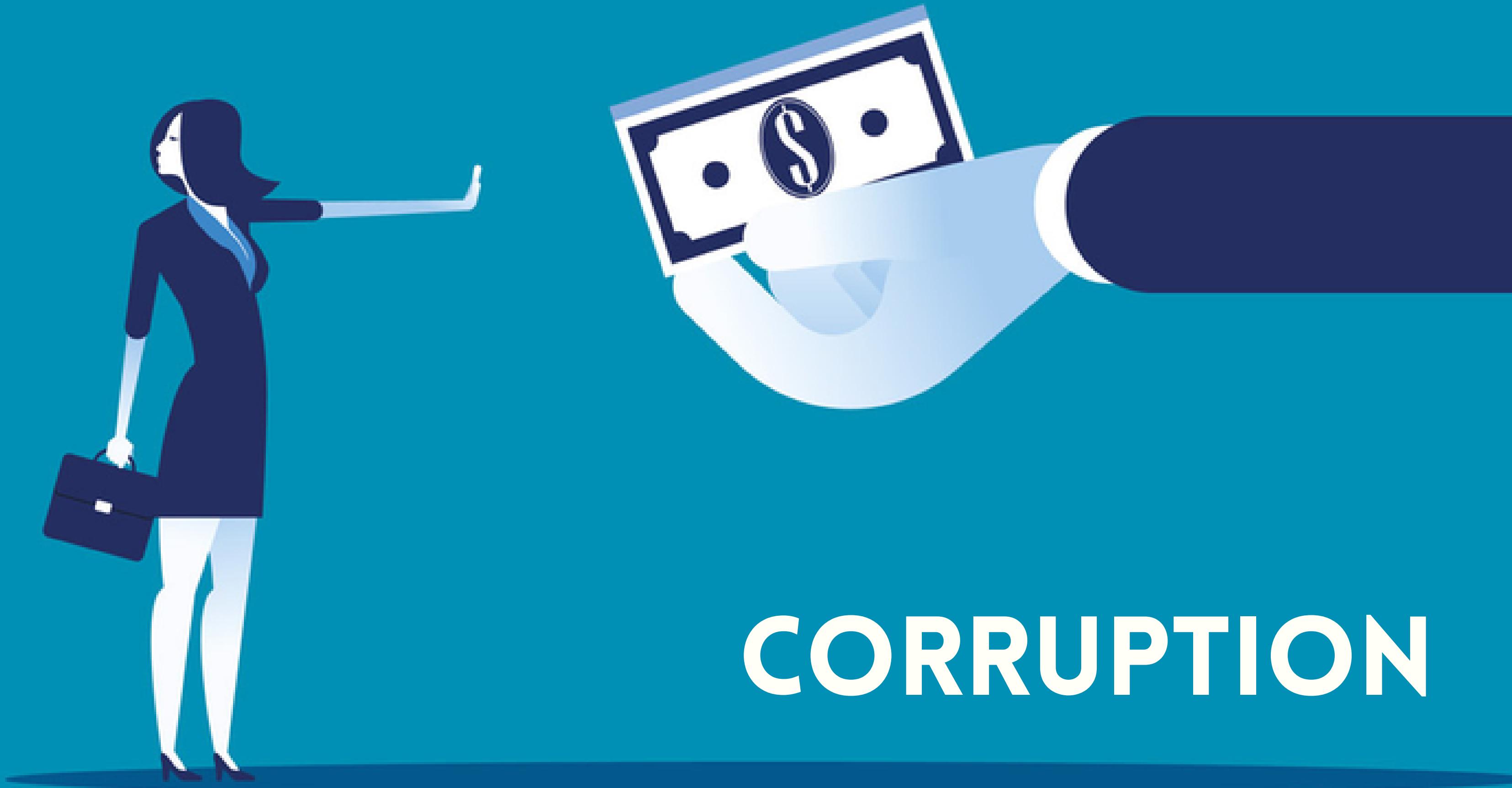
When this mutation occurs, workers become more interested in making babies than in working for the colony.

As the mutation becomes more prevalent, the colony itself becomes less productive.

Oldroyd, B. P., Smolenski, A. J., Cornuet, J.-M., & Crozler, R. H. (1994). Anarchy in the beehive. *Nature*, 371(6500), 749–749.
Ratnieks, F. L. W., Foster, K. R., & Wenseleers, T. (2006). Conflict resolution in insect societies. *Annual Review of Entomology*, 51, 581–608.

ok, but why aren't all bees anarchists?





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.

I don't see anything wrong with that.



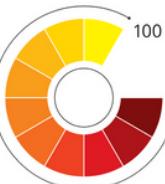
*aren't we all supposed to look
after our families?*

CORRUPTION PERCEPTIONS INDEX 2023

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

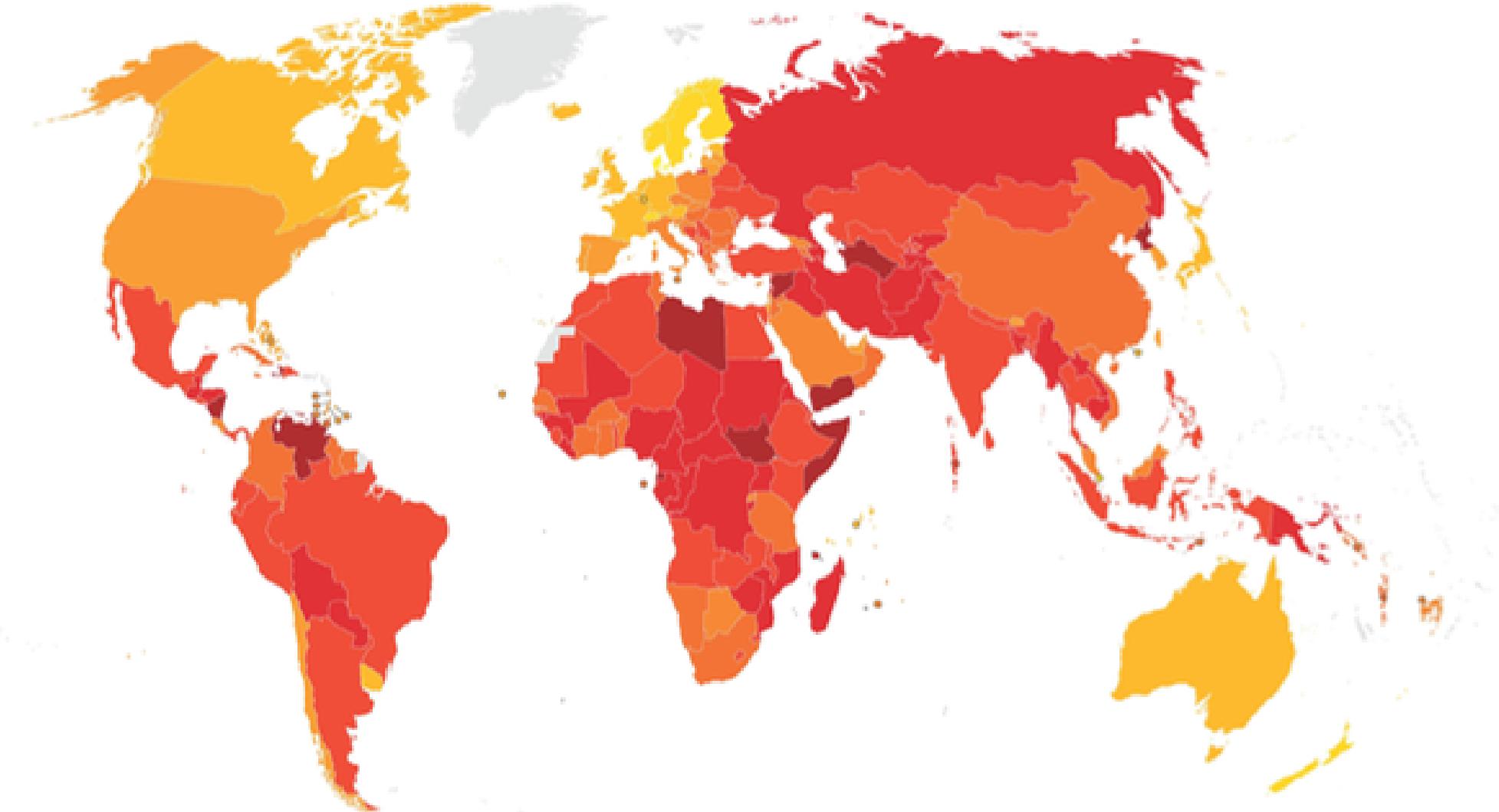
Notice anything?

SCORE	COUNTRY/TERRITORY
90	Denmark
87	Finland
85	New Zealand
84	Norway
83	Singapore
82	Sweden
82	Switzerland
79	Netherlands
78	Germany
78	Luxembourg
77	Ireland
76	Canada
76	Estonia
75	Australia
75	Hong Kong
73	Belgium
73	Japan
73	Uruguay
72	Iceland
71	Austria
71	France
71	Seychelles
71	United Kingdom
69	Barbados
69	United States
68	Bhutan
68	United Arab Emirates
67	Taiwan
66	Chile
64	Bahamas
64	Cabo Verde
63	Korea, South
62	Israel
61	Lithuania
61	Portugal
60	Latvia
60	Saint Vincent and the Grenadines
60	Spain
59	Botswana
58	Qatar
57	Czechia
56	Dominica
56	Italy
56	Slovenia
55	Costa Rica
55	Saint Lucia
54	Poland
54	Slovakia
53	Cyprus
53	Georgia
53	Grenada
53	Rwanda
52	Fiji
52	Saudi Arabia
51	Malta
51	Mauritius
50	Croatia
50	Malaysia
49	Greece
49	Namibia
48	Vanuatu
47	Armenia
46	Jordan
46	Kuwait
46	Montenegro
46	Romania
45	Bulgaria
45	Sao Tome and Principe
44	Jamaica
43	Benin
43	Ghana
43	Oman
43	Senegal
43	Solomon Islands
43	Timor-Leste
42	Bahrain
42	China
42	Cuba
42	Hungary
42	Moldova
42	North Macedonia
42	Trinidad and Tobago
41	Burkina Faso
41	Kosovo
41	South Africa
41	Vietnam
40	Colombia
40	Côte d'Ivoire
40	Guyana
40	Suriname
40	Tanzania
40	Tunisia
39	India
39	Kazakhstan
39	Lesotho
39	Maldives
38	Morocco
37	Argentina
37	Albania
37	Belarus
37	Ethiopia
37	Gambia
37	Zambia
36	Algeria
36	Brazil
36	Serbia
35	Ukraine
35	Bosnia and Herzegovina
35	Dominican Republic
35	Egypt
35	Nepal
35	Panama
35	Sierra Leone
35	Thailand
34	Ecuador
34	Indonesia
34	Malawi
34	Philippines
34	Sri Lanka
34	Turkey
33	Angola
33	Mongolia
33	Peru
33	Uzbekistan
32	Niger
31	El Salvador
31	Kenya
31	Mexico
31	Togo
30	Djibouti
30	Eswatini
30	Mauritania
29	Bolivia
29	Bosnia and Herzegovina
29	Papua New Guinea
28	Gabon
28	Laos
28	Mali
28	Paraguay
27	Cameroon
26	Guinea
26	Kyrgyzstan
26	Russia
26	Uganda
25	Liberia
25	Madagascar
25	Mozambique
25	Nigeria
24	Bangladesh
24	Central African Republic
24	Iran
24	Lebanon
24	Zimbabwe
23	Azerbaijan
23	Guatemala
23	Honduras
23	Iraq
22	Cambodia
22	Congo
22	Guinea-Bissau
21	Eritrea
20	Afghanistan
20	Burundi
20	Chad
20	Comoros
20	Democratic Republic of the Congo
20	Myanmar
20	Sudan
20	Tajikistan
18	Libya
18	Turkmenistan
17	Equatorial Guinea
17	Haiti
17	Korea, North
17	Nicaragua
16	Yemen
15	South Sudan
13	Syria
13	Venezuela
11	Somalia



THE CPI USES A SCALE
FROM 0 TO 100

100 is very clean and
0 is highly corrupt



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.



I don't see anything wrong with that.



JOE HENRICH

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

WEIRD
Western, Educated, Industrialized,
Rich, Democratic

Henrich, J. (2020). *The WEIRDest People in the World: How the West Became Psychologically Peculiar and Particularly Prosperous*. Farrar, Straus and Giroux.

+1.2°C 2.16°F

+1.0°

+0.8°

+0.6°

+0.4°

+0.2°

0°

-0.2°

1880

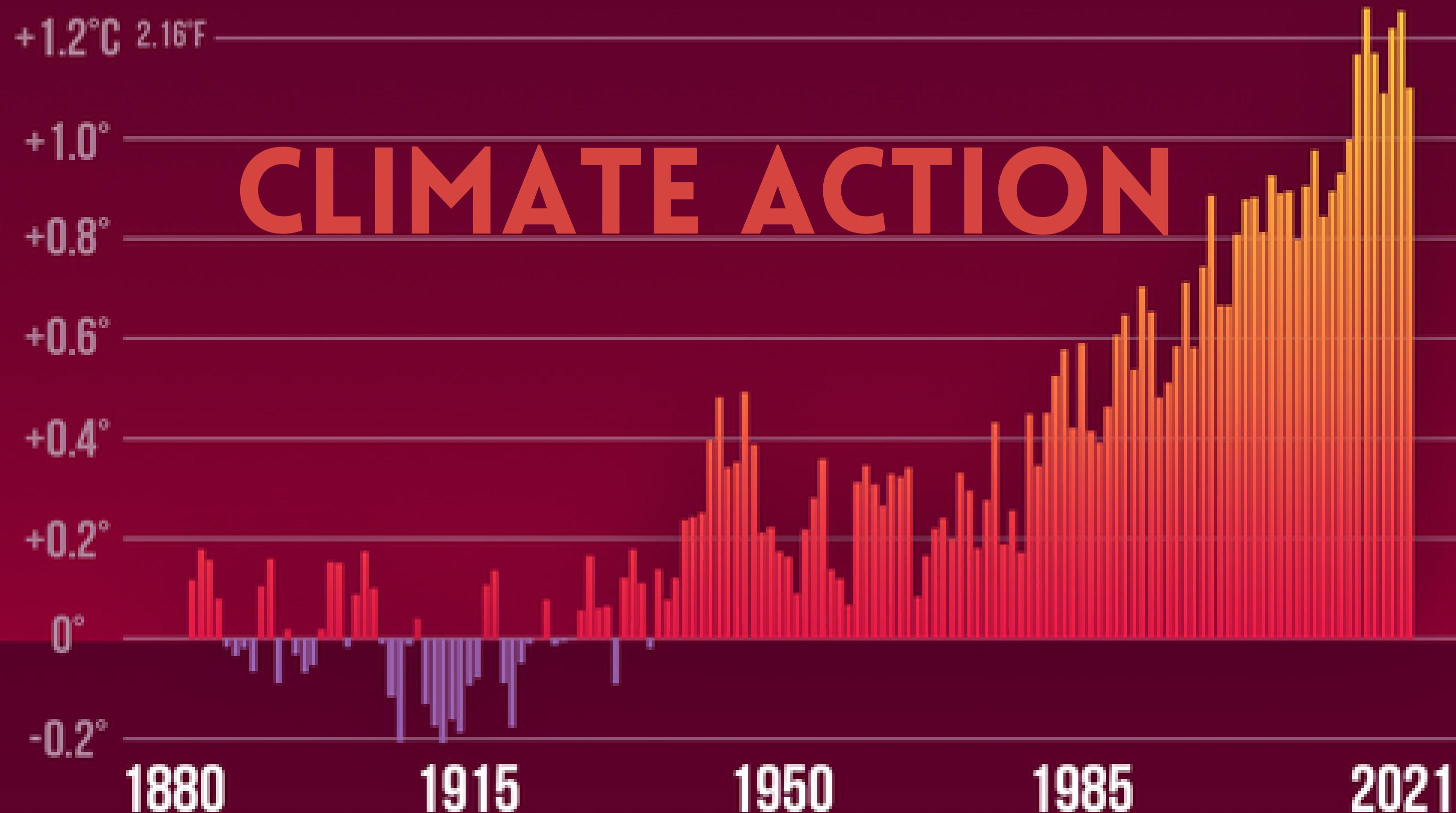
1915

1950

1985

2021

CLIMATE ACTION



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

CLIMATE CO₂ 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.



It will probably be impossible to get this through the US Congress in its current deadlocked state though...

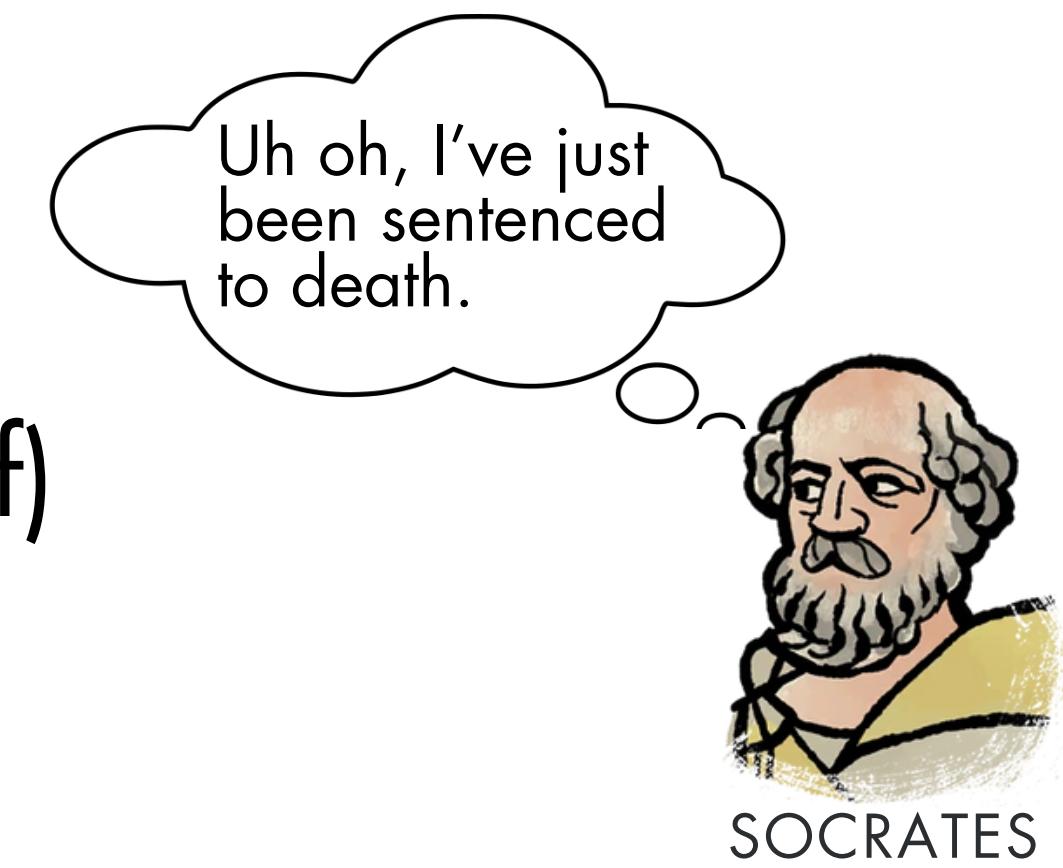
why wouldn't the US want to help
poorer countries?

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

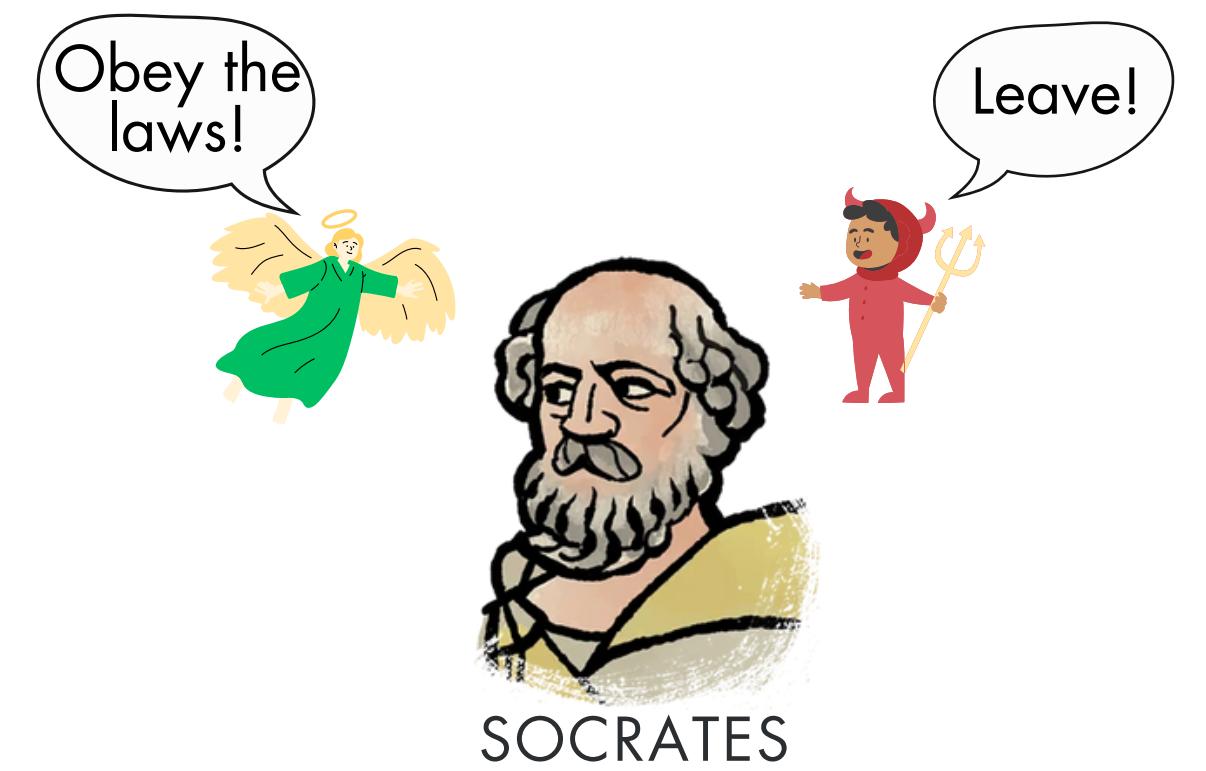
A cell, a worker bee, a person, a US congressman: why should they cooperate with others?

We've said that there's a cost to cooperation:
there's the rub.

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



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



We can make this drama more precise.

With a little detour through...

GAME THEORY