Why do cartels fall apart, and sometimes don't?

A **cartel** = sellers who agree not to compete, to keep prices high; each member could cheat and grab more. Played once, cheating wins. Played again and again, a cheat today is answered tomorrow: cooperation holds if tomorrow is worth enough. It breaks with many members, hidden cheating, a known last round or a huge one-off prize.

1 Played once

the trap of Lesson 1

- Each round: **cooperate** (keep the deal) or **defect** (cheat) · points `Ana / Ben`, more is better · **your move**: 10 rounds vs Ben (never graded or stored)
- Lesson: both coop **3 / 3** · cheat on a cooperator **5 / 0** · both defect **1 / 1** · defect: 5 > 3 and 1 > 0 ⇒ **dominant strategy** ⇒ once → **1 / 1** though 3 / 3 better for both
- **Dominant strategy**: "a move that is a player's best reply whatever the other player does" · **Nash equilibrium**: "each move a best reply to the other's" · **best reply** = the move that pays most, given the other's
- Practice · bakeries ($100s/week): both high 4 / 4 · cut vs high 6 / 0 · both cut 1 / 1 → cut dominant (6 > 4, 1 > 0) → **1 / 1**

LESSON · PLAYED ONCE · POINTS

	Ben Coop	Ben Defect
Ana Coop	3 / 3	0 / 5
Ana Defect	5 / 0	1 / 1

PRACTICE · BAKERIES · $100S/WEEK

	Ben High	Ben Cut
Ana High	4 / 4	0 / 6
Ana Cut	6 / 0	1 / 1

2 Many rounds

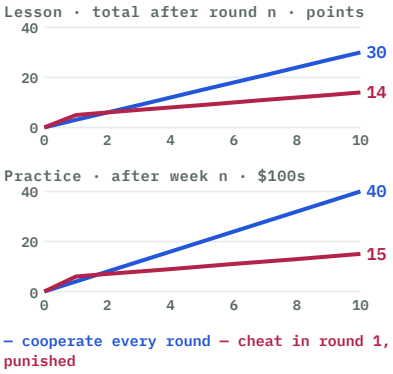
the shadow of the future

- **Repeated game**: same game, same players, again and again → a cheat today can be answered tomorrow
- **Shadow of the future**: "today's choice matters because the same players meet again tomorrow"
- **Tit-for-tat**: "cooperate first, then copy the other player's last move" · Ana defects in round 3 → Ben defects in round 4
- Your 10 rounds vs Ben (he played tit-for-tat): cooperate every round → **30** · cooperate 9, defect in round 10 → **32** ⇒ a **known last round** invites cheating

3 Counting the future

δ, the discount factor

- **δ** (Greek "delta") = what 1 point next round is worth today · < 1: the game may end, you may not meet again, impatience (Behavioral 6)
- 1 point every round, forever = 1 + δ + δ² + … = `1 ÷ (1 − δ)` · δ = 0.9 → **10** · δ = 0.8 → **5**
- Lesson, δ = 0.9: cooperate forever `3 × 10 = 30` · cheat once, then punished forever (Ben never forgives) `5 + 0.9 × 10 = 14` ⇒ **cooperate**
- Practice, δ = 0.8: keep the deal `4 × 5 = 20` · cut once `6 + 0.8 × 5 = 10` ⇒ keep · on a chart: cutting wins only week 1, ahead from week 2 (8 > 7) → 40 vs 15



4 The threshold

how patient?

- Cooperation holds if `δ ≥ (cheat − deal) ÷ (cheat − punishment)` · gain today vs loss every later round
- Lesson: `(5 − 3) ÷ (5 − 1) = ½` → "cooperation holds if tomorrow is worth at least half of today" · δ 0.9: 30 vs 14 · 0.5: **6 = 6** · 0.4: 5 vs ≈5.7 · 0.2: 3.75 vs 5.25 → cheat
- Practice: `(6 − 4) ÷ (6 − 1) = 0.4` · huge one-off order: cheat today 21 → `21 + 4 = 25 > 20` → Ben cuts · the punishment stays the same, the **temptation** grows

5 Real cases

what holds, what breaks

- **Robert Axelrod** (American political scientist): computer tournaments, **1980**, 14 then 62 programs → both won by **tit-for-tat** (Anatol Rapoport, Russian-born mathematician) · best traits: **nice** (never cheat first) · **retaliating** · **forgiving** · **clear**
- **OPEC** (Organization of the Petroleum Exporting Countries): oil-exporting governments, founded **1960** by 5, ≈ ⅓ of world crude oil (2025) · quotas (caps on output), cheating → Saudi Arabia pumps far more **1985–86**, price −⅔ · quota dispute with Russia → **price war** (all pump more, price falls) **March 2020** · **price-fixing** (firms agreeing on prices) illegal in most countries; OPEC's members are states
- Breaks × many members · secret cheating · a **known last round** (unravels backward, Lesson 4) · a one-off meeting · a huge one-off prize · holds ✓ meet often, cheats in plain sight (shared well, dish duty, market stalls)
- Chain: more firms → each cheat small and hidden → punishment less likely → cheating pays → cartel breaks

Watch out: once and repeated are **different games** · compare the **whole future**, not today's 5 vs 3 · cooperation is not automatic: only if δ ≥ the threshold · tit-for-tat punishes **one** round and forgives; the sums use a stricter "never forgive" to stay short