
Session 6

Getting together and stepping aside

- Coordination & Anti-Coordination Games -

What you will learn today: Our objectives

- **How should we behave in situations in which other people are also conformists? Or in which none of the other persons also wants to be a coward? Or in which we all love to be together?**
 - **The classical games and its equilibria**
- **How can we use these insights to explain how people behave in more complex situations?**
 - **Extensions**
- **How can we use strategic moves to assure others of our intentions, to avoid being a coward, or to simply coordinate with others? Why are strategic moves not universally valid independent of the underlying situation?**
 - **Strategic moves**

Our path to succeed: Course outline for today

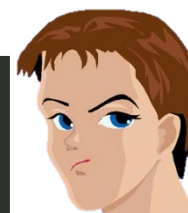
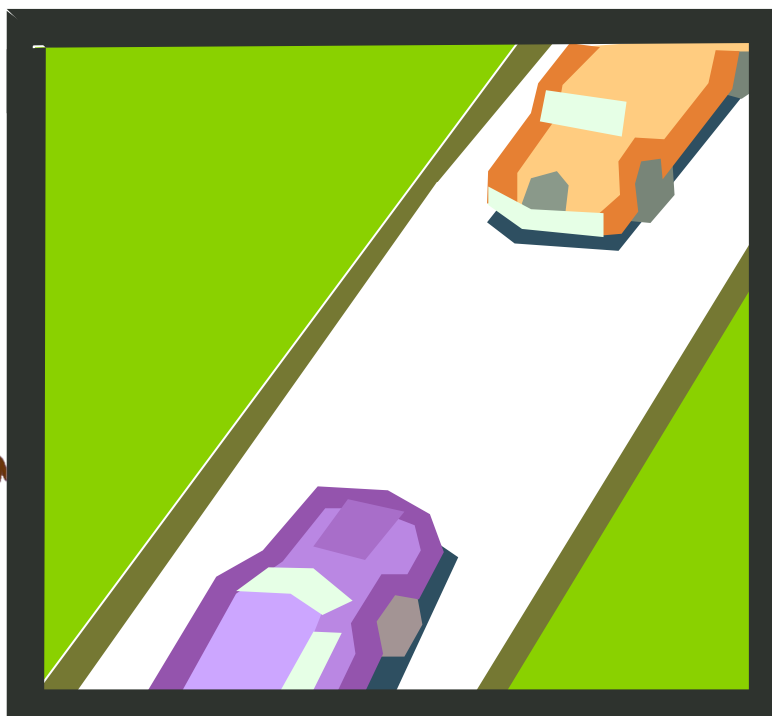
- **The classical games and its equilibria: Chicken, stag hunt, and pure coordination**
 - The Cuban missile crisis, October 1962
 - QWERTY, DSK, and the bandwagon effect
 - Adam, Eve and the Forbidden Fruit
- **Extensions: DSDS, the war of attrition, and the coordination for revolution**
 - Monday Demonstrations in Leipzig, Sep/Oct 1989
- **Strategic moves: Taking the initiative, building reputation, conventions, and cheap talk**
 - Hernán Cortés' burning bridges
 - The lighthouse and naval vessel urban legend

The classical story of the chicken game

- In pursuit of testosterone-inspired adventures, two young car drivers, James and Dean, are facing each other in a duel-like fashion: As the cars come hurtling towards one another, each driver is deciding whether to swerve to avoid a collision or to hang tough, hoping that the other will swerve.
- The one who first leaves the collision course and swerves off is chicken-hearted and loses the duel. If both swerve, nobody has won, but at least they get off lightly. In contrast, if both are determined not to give in, they provoke the worst possible outcome.



James



Dean

How to behave in the chicken game: Avoid to cooperate



| | | <i>swerve</i> <i>hang tough</i> | |
|--|-------------------|---------------------------------|-------------------|
| | | <i>swerve</i> | <i>hang tough</i> |
|  James | <i>swerve</i> | 2,2 | 1,3 |
| | <i>hang tough</i> | 3,1 | 0,0 |

Definition: A **2x2 anti-coordination game** is a game with three equilibria: one symmetric equilibrium in mixed strategies and two asymmetric equilibria in pure strategies. Both players have opposite rankings of the pure-strategy equilibria and both prefer not to coordinate.

Case study: The Cuban missile crisis, October 1962

Map showing the full range of the nuclear missiles under construction in Cuba



The history:

July 1962: Soviet Union starts installing nuclear-armed missiles in Cuba that were capable of hitting a large portion of the US.

Oct 15: Photographic evidence of the missiles

Oct 16: Among several other strategies, US policy makers considered a naval blockade called quarantine to prevent shipment of more missiles, as well as an air strike to wipe out the missiles already installed. The alternatives open to Soviet policy makers were either to withdraw or maintain the missiles.

Oct 22: Kennedy's speech to the nation

Oct 24: US starts blockade

Oct 28: Soviets withdraw their missiles

USSR

*with-
drawal* *main-
tenance*



US
*bloc-
kade*

*air
strike*

| | | |
|--|------------|------------|
| | 3,3 | 2,4 |
| | 4,2 | 1,1 |

The “classical” story of a pure coordination game

- You and a fellow student are on exchange in the US, visiting different colleges. As both of you have never been in New York City before, you want to meet there. By arriving in New York, you realize that you did not arrange where and when to meet that day. While searching your bag for your mobile phone to ring your friend, you realize that you left it in your college dorm.
- As there is no alternative way of communication between you and your friend, you both look at the map of New York City and choose where to go to hopefully meet each other.



Detailed tourist map of Manhattan,, retrieved from Vidiani.com, copyright is believed to belong to Vidiani

How to behave in a pure coordination game: Coordinate your behavior in a focal point



Empire State Building, 13pm
 Empire State Building, 15pm

 Central Station, 12pm
 Central Station, 18pm
 ...
 Rockefeller Center, 15pm

| | Empire State Building, 13pm | Empire State Building, 15pm | .... | Central Station, 12pm | Central Station, 18pm | ... | Rockefeller Center, 15pm |
|-----------------------------|-----------------------------|-----------------------------|------|-----------------------|-----------------------|------|--------------------------|
| Empire State Building, 13pm | 1,1 | 0,0 | .... | 0,0 | 0,0 | .... | 0,0 |
| Empire State Building, 15pm | 0,0 | 1,1 | .... | 0,0 | 0,0 | .... | 0,0 |
| .... | 0,0 | 0,0 | .... | 0,0 | 0,0 | .... | 0,0 |
| Central Station, 12pm | 0,0 | 0,0 | .... | 1,1 | 0,0 | .... | 0,0 |
| Central Station, 18pm | 0,0 | 0,0 | .... | 0,0 | 1,1 | .... | 0,0 |
| ... | 0,0 | 0,0 | .... | 0,0 | 0,0 | .... | 0,0 |
| Rockefeller Center, 15pm | 0,0 | 0,0 | .... | 0,0 | 0,0 | .... | 1,1 |

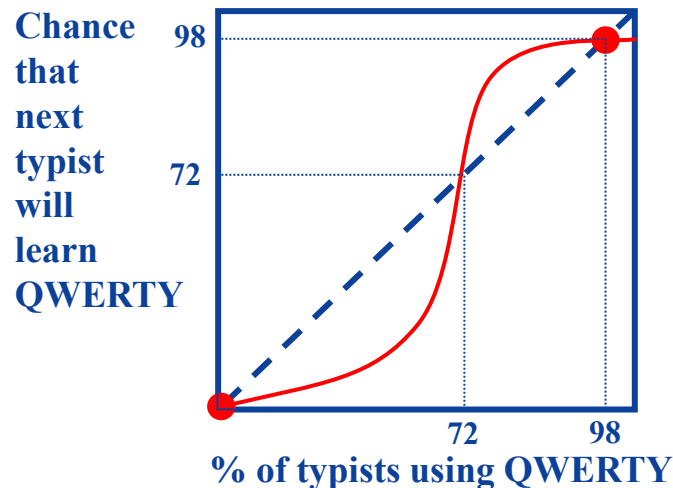


Definition: A 2x2 pure coordination game is a game with three equilibria: one symmetric equilibrium in mixed strategies and two symmetric equilibria in pure strategies. Both players have the same rankings of the pure-strategy equilibria.

Case study: QWERTY, DSK, and the bandwagon effect



A QWERTY keyboard



The history:

1860: Invention of the first typewriters without a standard pattern for the arrangement of letters on the keyboard and several jamming problems of keys.

1873: Creation of the QWERTY layout by Christopher Scholes – named after the letter arrangement of the six letters in the top row – with the advantage to maximize the distance between the most frequent used letters to slow down the typist and reduce jamming.

1932: The Dvorak Simplified Keyboard (DSK) was developed by August Dvorak and "lets you type 20-40% faster" (Apple Adv)

| | | | | | | | | | | | | | |
|-----------|---------|-----|---|----|---|---|---|---|---|--------|---------|-----------|------|
| ~ | ! | @ | # | \$ | % | ^ | & | * | (|) | { | } | ← |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 0 | [|] | Backspace | |
| Tab | " | < | > | P | Y | F | G | C | R | L | ? | + | \| |
| ↵ | , | . | / | = | \ | | | | | | | | |
| Caps Lock | A | O | E | U | I | D | H | T | N | S | - | Enter | |
| ↕ | | | | | | | | | | | | ↵ | |
| Shift | : | Q | J | K | X | B | M | W | V | Z | Shift | | |
| ↵ | ; | | | | | | | | | | ↵ | | |
| Ctrl | Win Key | Alt | | | | | | | | Alt Gr | Win Key | Menu | Ctrl |

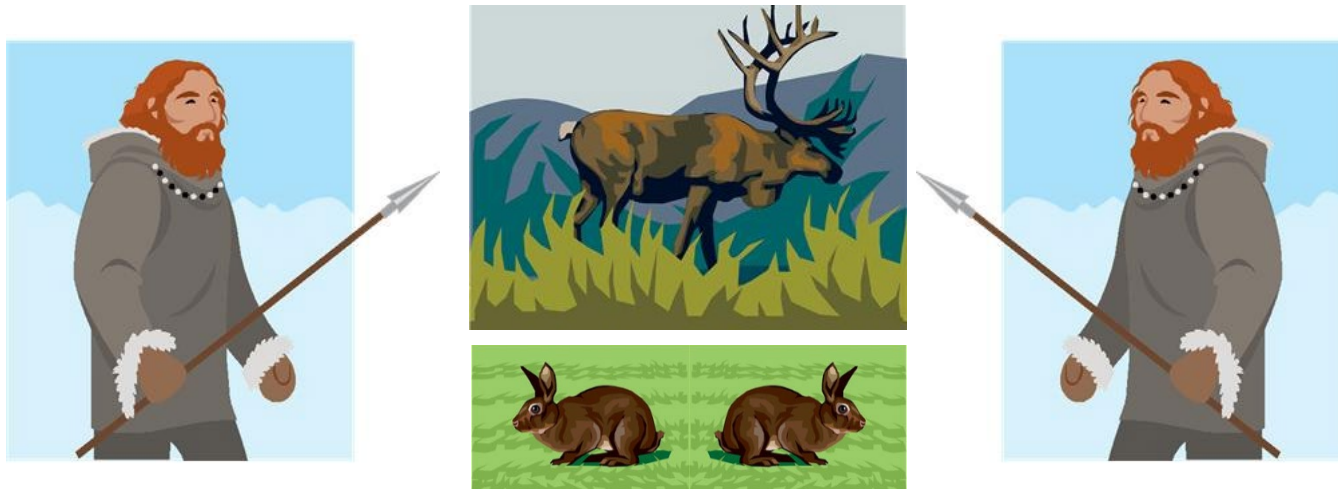
A DSK keyboard

The classical story of the stag hunt game

“If it was a matter of catching a deer, each man sensed well that to do so he should keep his position faithfully. But if a hare happened to go past within reach of one of them, one can be sure he went after it without a scruple and, having caught his prey, cared very little about making his companions lose theirs.”



Rousseau, J. J. (1754). Discourse on the origin and the foundation of the inequality among man

- Two hunters go on a hunt. They can either shoot a stag or a hare. They can hunt the stag only successfully together, but hunt the hare successfully on their own.
- If they cooperate to trap the stag, they will both eat well. But if one person defects to chase a hare, which he likes less than a stag, the other hunter will get nothing.



How to behave in the stag hunt game: Give assurance to cooperate

| | | | |
|-----------------|-------------|-----------------|-------------|
| | | Hunter 2 | |
| | | <i>stag</i> | <i>hare</i> |
| Hunter 1 | <i>stag</i> | 3,3 | 0,1 |
| | <i>hare</i> | 1,0 | 1,1 |

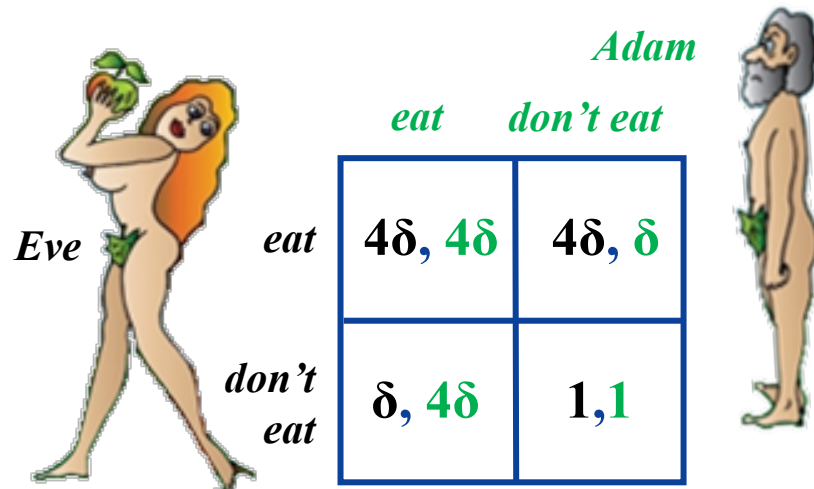



Definition: A **2x2 game of dangerous coordination** is a game with three equilibria: one symmetric equilibrium in mixed strategies and two symmetric equilibria in pure strategies. Both players have the same rankings of in the pure-strategy equilibria but off-equilibrium payoffs are worse for the best ranked equilibrium.

Case study: Adam, Eve, and the Forbidden Fruit

The story:

- In the Book of Genesis, Gen 2, God places Adam in the Garden of Eden but prohibits Adam from eating fruits from the forbidden tree in the middle of the garden.
- In a dialogue with the serpent, Eve says to the serpent, “We may eat fruit from the trees in the garden, but God did say, ‘You must not eat fruit from the tree that is in the middle of the garden, and you must not touch it, or you will die.’” “You will certainly not die,” says the serpent to Eve. “For God knows that when you eat from it your eyes will be opened, and you will be like God, knowing good and evil.”




where $\delta \in (0,1)$ is their knowledge of surviving.

- Then both eat if $\delta \geq \frac{1}{4}$
- Otherwise, for $\delta \leq \frac{1}{4}$, there are two equilibria, where (1,1) Pareto-dominates (4δ, 4δ)
- Adam and Eve sin and God banishes them from the Garden of Eden.


Extending the stag hunt game: DSDS and the supporting of Tim Birkenbaum



- Julia, Marie, and Sophie have just landed tickets to attend this week’s show of “Deutschland sucht den Superstar” - DSDS. The three teens have the same favorite among the remaining contestants: Tim Birkenbaum. To make a statement, they come up with the idea to wear T-shirts that spell out “TIM” in large letters. Julia is to wear a T-shirt with a big “T”, Marie with an “I” and Sophie with a “M”.
- While they all like this plan, each is tempted to wear instead an attractive new top just purchased from their latest shopping expedition at H&M. It’s now an hour before they have to leave to meet at the studio, and each is at home trying to decide what to wear:




„M“
Marie




Sophie

H&M




Marie



Julia

| | „I“ | H&M |
|-----|---------|---------|
| „T“ | 2, 2, 2 | 0, 1, 0 |
| H&M | 1, 0, 0 | 1, 1, 0 |

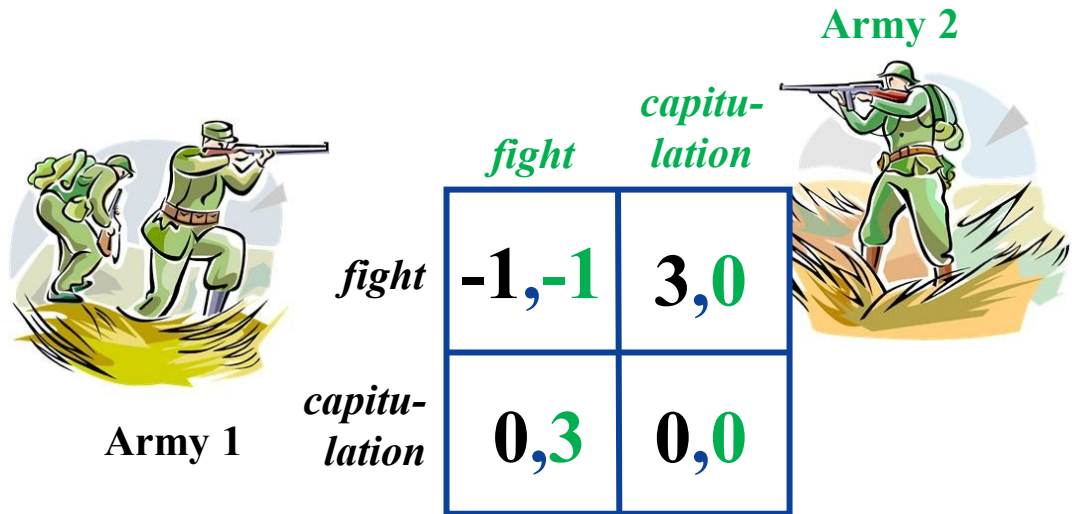


Julia

| | „I“ | H&M |
|-----|---------|---------|
| „T“ | 0, 0, 1 | 0, 1, 1 |
| H&M | 1, 0, 1 | 1, 1, 1 |

Extending the chicken game: The War of Attrition and the timing of capitulation

- Two armies are opposing each other on the front line of a war, dug into trenches. The situation is characterized by little movement in the last month, battles that lasted for weeks, and a steady stream of casualties. Each side incurred heavy costs as it waits for the enemy to capitulate.



Payoffs per time period



Let V_F and V_C be the expected discounted value of an army's payoff for fighting or capitulating with a discount factor r , and p be the probability to capitulate, then

$$V_F = 3p + (1-p)(-1 + V_F/r) \text{ and } V_C = 0$$



$$V_F = (4p-1)(1+r/r+p) = V_C = 0 \text{ if } p = 1/4$$

Extending the pure coordination game: Civil unrest and the coordination for revolution

- Consider a nondemocratic society with 500 citizens, each of whom is deciding whether to protest



| type of citizen | number of citizen | cost of protesting | benefits of protesting | critical mass |
|-----------------|-------------------|--------------------|------------------------|---------------|
| Radical | 100 | 6.000 | $50 * m$ | 120 |
| Progressive | 100 | 8.000 | $50 * m$ | 160 |
| Bourgeois | 300 | 20.000 | $50 * m$ | 400 |

where m is the number of protesting citizens



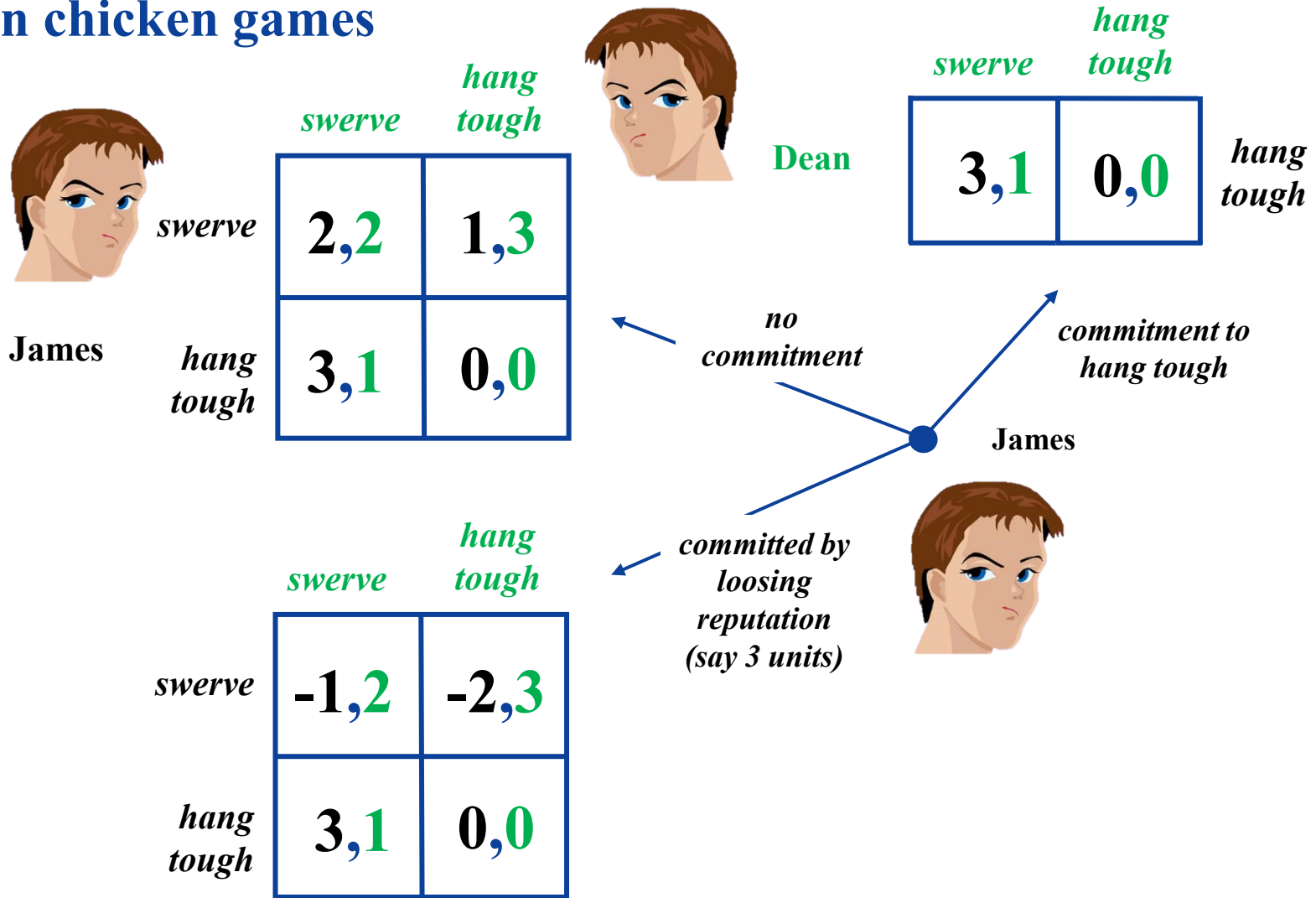
- No one protesting is an equilibrium, $m^* = 0$
- Only radicals and progressives protesting is an equilibrium, $m^* = 200$
- All citizen protesting is an equilibrium, $m^* = 500$

Case study: Monday demonstrations in Leipzig, East Germany, Sep/Oct 1989

| date | turnout | incidence |
|---------------|---------|---|
| Sep. 25, 1989 | 6.500 | Some people were arrested |
| Oct. 02, 1989 | 17.918 | Authorities used violence |
| Oct. 09, 1989 | 60.300 | <p>Before the demonstration, Honecker signed the firing order for a Chinese solution to the protest: large containers of tear gas were unloaded in the Leipzig freight yard. The hospitals prepared for a bloodbath by setting up extra beds and acquiring additional blood reserves. Helmets, shields, riot sticks, and gas masks were distributed to the police. A unit of the National People's Army from the southern GDR was equipped with lethal munitions. Combat groups were assembled. At 5:45 p.m., the police and the military withdrew.</p> |
| Oct. 16, 1989 | 120.000 | |
| Oct. 23, 1989 | 245.000 | |
| Oct. 30, 1989 | 284.545 | |
| Nov. 06, 1989 | 325.000 | |



Taking the initiative or building reputation as strategic moves in chicken games



Case study: Hernán Cortés' burning bridges

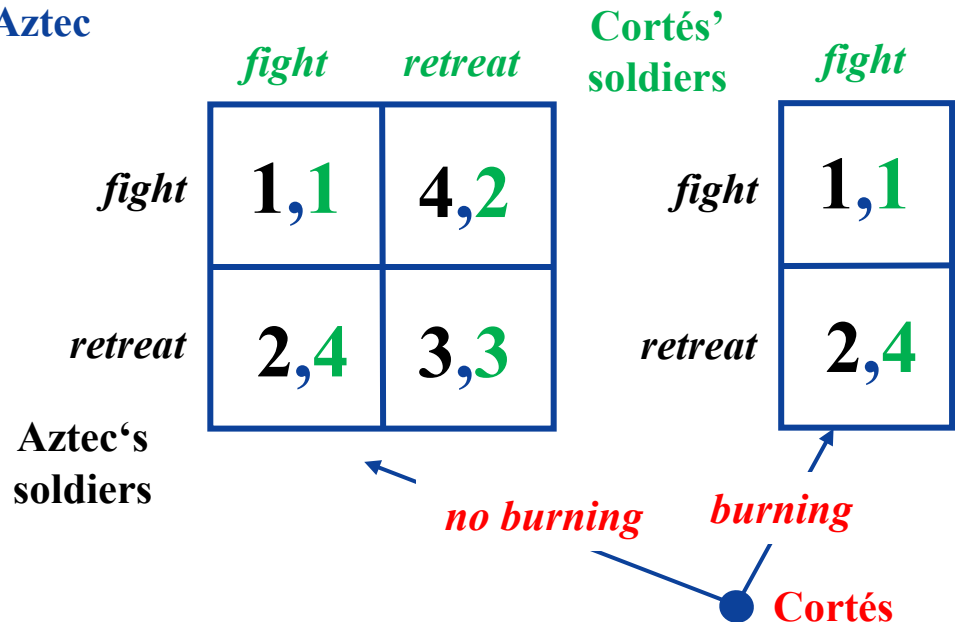


The history:

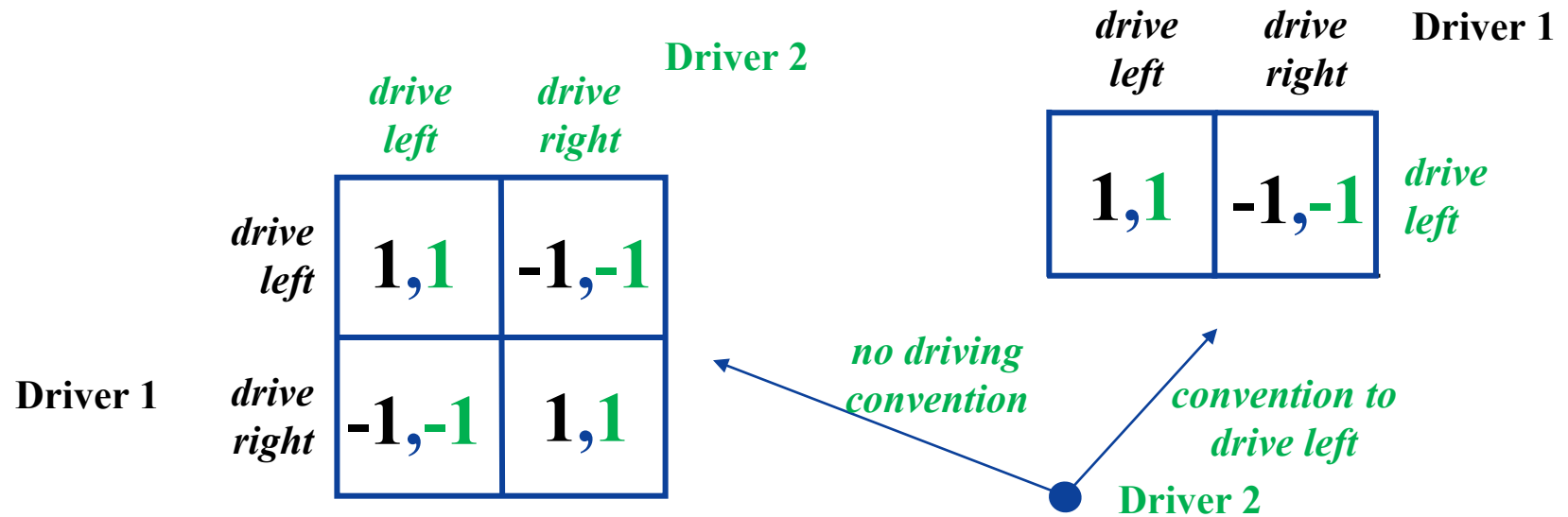
- Born 1485 in Spain, Hernán Cortés left for the New World in 1504, first to Hispaniola, then to Cuba where he met the Governor Velázquez. In 1518, Velázquez put him in command of an expedition to explore the Mexican coast which ended in the conquest of the Aztec Empire in 1521.



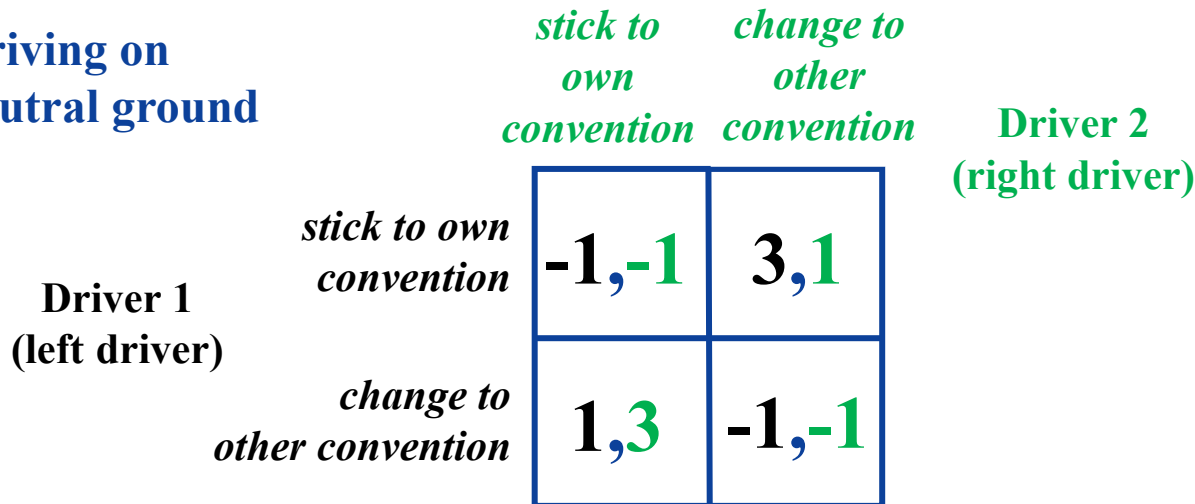
- On his expedition along the coast he found Veracruz in April 1519 from where he started his march to Tenochtitlan in the interior of Mexico.
- To eliminate any ideas of retreat, Cortés scuttled his ships.



Conventions as strategic move in coordination games




Driving on neutral ground



Cheap talk as strategic move in pure coordination games

- Susan and Roberto work at the same office building in a small town and are both going to eat out tonight. They want to eat together. There are three eateries in town; the Spanish and Japanese eatery are of equal quality, but the third- down by the town's (sole) railroad station, Grand Empire Station - is of lower quality. Their preferences are as follows:



Roberto

Japanese Eatery Spanish Eatery Empire

Susan

| | | | |
|------------------------|-----|-----|-----|
| <i>Japanese Eatery</i> | 3,3 | 0,0 | 0,0 |
| <i>Spanish Eatery</i> | 0,0 | 3,3 | 0,0 |
| <i>Empire</i> | 0,0 | 0,0 | 1,1 |

- Susan and Roberto are leaving from the same parking garage, using separate cars parking next to each other. Suppose Susan says: “I’m off to the Japanese!”

This message is

- **self-signaling:** Susan wants to say it if and only if it is true
- **self-committing:** If believed by Roberto, Susan has an incentive to go there

....but not in stag hunt games

- Susan and Roberto work at the same office building in a small town and are both hungry after work. Because both just start working in that building they plan to eat together tonight hoping that this might lead to a love affair. However, they have different eating preferences. Susan likes Japanese food, whereas Roberto goes for Spanish food. If they find a compromise and go the Empire eatery, chances are high for a love affair. If, however, one of them insists on its preferences, they will probably never fall in love.



Roberto

accept a compromise

insist on own preferences

Susan

accept a compromise

| | | | |
|--|--|------------|------------|
| | | 3,3 | 0,2 |
| | | 2,0 | 1,1 |

insist on own preferences

- Susan and Roberto are leaving from the same parking garage, using separate cars parking next to each other. Suppose Susan says: “I’m off to the Empire!”

This message is

- self-committing:** If believed by Roberto, Susan has an incentive to go there
- not self-signaling:** Susan would say it even if she plans to go to the Japanese

Case study: The lighthouse and naval vessel urban legend

This is the transcript of a radio conversation of a US naval ship with Canadian authorities off the coast of Newfoundland in October, 1995. Radio conversation released by the Chief of Naval Operations 10-10-95:

Americans: Please divert your course 15 degrees to the North to avoid a Collision.

Canadians: Recommend you divert YOUR course 15 degrees to the South to avoid a collision.

Americans: This is the Captain of a US Navy ship. I say again, divert YOUR course.



The lighthouse



The USS Lincoln

Canadians: No. I say again, you divert YOUR course.

Americans: This is the second largest ship in the United States' Atlantic fleet. We are accompanied by three destroyers, three cruisers and numerous support vessels. I demand that YOU change your course 15 degrees North, that's one five degrees North, or countermeasures will be undertaken to ensure the safety of this ship.

Canadians: This is a lighthouse. Your call.

Coordination & Anti-Coordination Games: What we learned today

- **Chicken games are situations in which nobody wants to be a coward. But if the other insists to be strong it is better for me to be a coward. So let's be the first who is strong.**
- **Stag hunt games are social dilemma situations: Although people want to cooperate they have conflicting interests. If one is willing to compromise he is not only worse off than the other who insists on his interests but also worse off than not cooperating in the first place. Only credible strategic moves assure mutual benefits.**
- **Pure coordination games are situations in which all people want to coordinate their behavior without any conflicting interests but where people can't for some reason. So let's communicate or rely on conventions.**

Further readings

- **Jost, P.-J. & U. Weitzel, 2007. Strategic Conflict Management. Edward Elgar: Chapters 2.1.6, 2.1.7, 2.1.1.**
- **Dixit, A. & S. Skeath, 1999. Games of Strategy. Norton: Chapters 4.11, 5.4.**
- **Schelling, T. C., 1990. The Strategy of Conflict. Harvard University Press: Chapter 3.**