

Game Theory at the Movies 6: *Incomplete Information and Signaling*

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Outline

- Incomplete information: types, beliefs, and Bayes' rule.
- *The Usual Suspects* (1995): cheap talk.
- *The Hunt for Red October* (1990): signals and indices.
- *Trading Places* (1983): learning from other traders.

Types and Beliefs

- A player's **type** is private information (guilty or innocent, defector or attacker).
- Others hold a prior belief about it and update with **Bayes' rule**:

- $$\Pr(\text{type} \mid \text{evidence}) = \frac{\Pr(\text{evidence} \mid \text{type}) \Pr(\text{type})}{\Pr(\text{evidence})}.$$

- Evidence is informative only if its probability differs across types.

The Usual Suspects (1995)



Theatrical release poster.

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Who Controls the Story

- Verbal Kint, a small-time crook, tells a detective the story behind a massacre.
- He blames a shadowy crime lord, Keyser Söze.
- After Verbal walks free, the detective sees that the story was built from the bulletin board.
- Verbal is almost certainly Söze himself.

Cheap Talk

- **Cheap talk:** messages that cost nothing and cannot be verified.
- Every type of Verbal wants to be released, so every type tells the same story.
- Then $\Pr(\text{story} \mid \text{Söze}) = \Pr(\text{story} \mid \text{not Söze})$: the posterior equals the prior.
- Only a **babbling equilibrium** exists (Crawford and Sobel, 1982).

Cheap Talk Today

- Large language models produce fluent text at almost no cost.
- Nothing in the text marks which parts are true.
- 2023: two New York lawyers filed a brief citing cases that a chatbot had invented.
- The court sanctioned them: check before acting on a free message.

The Hunt for Red October (1990)



Theatrical release poster.

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Defector or Attacker?

- Captain Marko Ramius (Sean Connery) commands a new, silent Soviet submarine.
- The Soviet ambassador tells the Americans that Ramius plans a missile attack.
- CIA analyst Jack Ryan believes Ramius means to defect.
- Whom should the Americans believe?

Evidence the Ambassador Offers

- Prior: $\Pr(\text{Defect}) = 0.5$ (illustrative).
- The Soviets would call Ramius a renegade whether he defects or attacks:
- $\Pr(\text{claim} \mid \text{Defect}) = \Pr(\text{claim} \mid \text{Attack}) = 1$.
- Posterior: still 0.5. The claim carries no information.

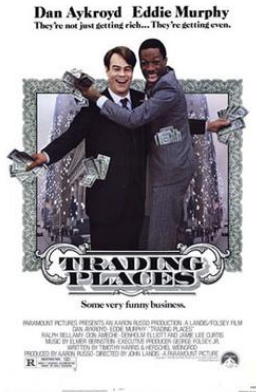
Evidence Ramius's Behavior Offers

- Suppose Ramius avoids every target while evading the Soviet fleet.
- Illustrative likelihoods: 0.9 if he defects, 0.2 if he attacks.
- $\Pr(\text{Defect} \mid \text{behavior}) = \frac{0.9 \times 0.5}{0.9 \times 0.5 + 0.2 \times 0.5} \approx 0.82.$
- Behavior that is hard to fake moves beliefs; words that are easy to fake do not.

Signals and Indices

- Jervis (1970): *signals* are statements that cost little and can deceive.
- *Indices* are behavior tied to real capabilities or intentions, hard to fake.
- Ryan builds his case on indices and discounts the ambassador's signals.
- Ramius's letter announcing his defection also burns his bridges, like Odysseus at the mast.

Trading Places (1983)



Theatrical release poster.

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The Stolen Crop Report

- The Duke brothers pay to steal the government's orange-crop report before its release.
- Winthorpe and Valentine swap in a forged report predicting a poor harvest.
- The Dukes buy orange juice futures heavily, and the floor buys with them.
- The real report says the crop is normal: the price collapses.

The Floor Learns from the Dukes

- Traders' prior: $\Pr(\text{bad crop}) = 0.3$ (illustrative).
- The Dukes buy heavily with probability 0.9 if the crop is bad, 0.1 if not.
- $\Pr(\text{bad} \mid \text{Dukes buy}) = \frac{0.9 \times 0.3}{0.9 \times 0.3 + 0.1 \times 0.7} \approx 0.79$.
- Everyone buys, so the price rises: the Dukes' orders are news.

Insider Trading in Theory and Law

- Kyle (1985): an informed trader hides his orders among ordinary trading.
- The Dukes trade heavily and openly, so the price moves at once.
- 2010: the Dodd–Frank Act banned trading futures on misappropriated government information.
- CFTC chairman Gary Gensler called it the “Eddie Murphy rule.”

Summary

- Evidence is informative only if its probability differs across types.
- *The Usual Suspects*: when every type says the same thing, talk is cheap.
- *The Hunt for Red October*: costly behavior (indices) tells more than cheap words (signals).
- *Trading Places*: markets learn from orders, which a forged report can exploit.