# Formal Analysis: Cheap talk

Andy Eggers

Week 6 Session 2

# Communication and cooperation

Asked to play one-shot prisoner's dilemma (or similar), players cooperate more if they communicate face-to-face beforehand (e.g. Ostrom 1997).

| | | Player 2 | |
|---|---|---|---|
| | | Cooperate | Defect |
| Player 1 | Cooperate | 3,3 | 1,4 |
| | Defect | 4,1 | 2,2 |

Why might this be?

# Cheap talk

**Definition**: message sent from one party to another that is not **payoff-relevant** for any player

- No cost for sending (not a **costly signal**, i.e. "sunk-cost" signal)
- Does not affect cost or benefit of future actions (not a "tying-hands" signal)

And yet, ignoring **psychological** mechanisms, can convey information *if the players have some shared interest*.

# Political science applications

When do we care about communication?

- Lobbying: interest group telling politician about its policy area
- Veto threats: one veto player telling another about her policy preferences (e.g. Matthews 1989 QJE)
- Legislative organization: committees (and other delegated bodies) acquire expertise that they communicate to the legislature (Gilligan and Krehbiel 1989 AJPS)
- Mediation: mediator telling party to a dispute about other side's resolve, etc (Kydd 2003 AJPS)

# Lobbying illustration

# Lobbying illustration: set up

There is a bill in the legislature.

MP must vote for, vote against, or abstain.

Lobbyist knows whether the bill helps or hurts the MP's constituents, and can tell the truth or lie to the MP.

MP wants to vote for the bill if it helps and against if it hurts; MP thinks $\Pr(\text{helps}) = 1/2$.

# Case 1: No common interest

Order of payoffs: Lobbyist, MP

| | | MP's vote | | |
|---|---|---|---|---|
| | | For | Against | Abstain |
| Effect of bill on MP's constituents | Helps | 3,3 | -1,0 | 0,2 |
| | Hurts | 3,0 | -1,3 | 0,2 |

Suppose lobbyist says "It helps." What should the MP do?

# Case 2: Common interest

Order of payoffs: Lobbyist, MP

| | | MP's vote | | |
|---|---|---|---|---|
| | | For | Against | Abstain |
| Effect of bill on MP's constituents | Helps | 3,3 | -1,0 | 0,2 |
| | Hurts | -1,0 | 3,3 | 0,2 |

Suppose lobbyist says "It helps." What should the MP do?

# Treaty game

# Treaty game: payoffs

State 1 (**sender**) and State 2 (**receiver**) face a choice about whether to implement a treaty to take joint action against climate change.

The benefit of implementing a treaty depends on the state of the world $\omega$, which could be

- $\omega_1$: climate change is not that serious
- $\omega_2$: climate change is serious

The payoff of implementing the treaty for player $i$ is $b(\omega) - c_i$; the payoff of not implementing the treaty is 0.

**Assumption**: $b(\omega_1) < c_2 < b(\omega_2)$, i.e. state 2 wants to take action if climate change is serious, but not otherwise.

# Treaty game: information and communication

State 1 (**sender**) receives a scientific report about how serious climate change is.

State 1 communicates one of two messages to State 2 (**receiver**):

- "Climate change is serious."
- "Climate change is not that serious."

**Question:** Under what conditions is there a *truthful equilibrium* in which

- State 1 reports honestly what the report says
- State 1 signs the treaty if the report says that climate change is serious
- State 2 signs the treaty if State 1 says that climate change is serious

# Variants of the treaty game

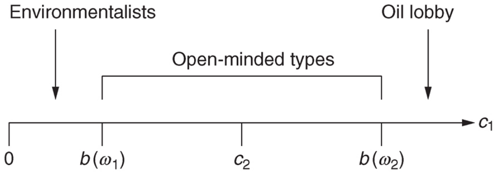
Kydd considers three variants:

| Pr(error in report) ($\epsilon$) | Receiver's knowledge of sender's preferences/costs ($c_1$) |
|---|---|
| Zero | Perfect |
| Non-zero ($\epsilon \in (0, .5)$) | Perfect |
| Non-zero ($\epsilon \in (0, .5)$) | Imperfect (described by $F(c_1)$) |

# Case 1: report is 100% accurate, state 1's type is known

Three types of state 1 to consider:

- "open-minded" like State 2 ($b(\omega_1) < c_1 < b(\omega_2)$)
- "environmentalist" ($c_1 < b(\omega_1)$)
- captured by the "oil lobby" ($c_1 > b(\omega_2)$)




Truthful equilibrium only possible if state 1 is "open-minded", i.e. has the same preferences as state 2.

# Case 2: report is wrong with probability $\epsilon$, state 1's type is known

Suppose the report is wrong with probability $\epsilon$.

Denote by $\rho_1$ a report saying "Climate change is not very serious ($\omega_1$)" and $\rho_2$ a report saying "Climate change is serious ($\omega_2$)".

Then $P(\rho_1|\omega_2) = P(\rho_2|\omega_1) = \epsilon$.

Suppose state 1 gets a report of $\rho_1$. What is the probability that climate change is serious (i.e. $P(\omega_2|\rho_1)$)?

# Bayes' Law

Relationships among **joint**, **conditional**, and **prior** probabilities:

$$P(\rho_1, \omega_2) = P(\rho_1|\omega_2)P(\omega_2) = P(\omega_2|\rho_1)P(\rho_1)$$

Therefore

$$P(\omega_2|\rho_1) = \frac{P(\rho_1|\omega_2)P(\omega_2)}{P(\rho_1)}.$$

See animation: https://andyeggers.shinyapps.io/cheap_talk/

# Bayes' Law and the treaty game

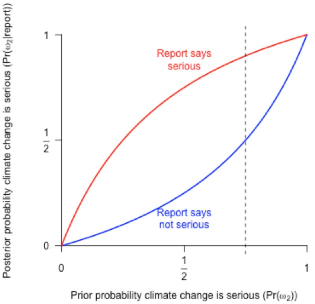
The expected benefit of the treaty, given a signal of $\rho_1$ (i.e. "Climate change is not that serious"):

$$E[b|\rho_1] = (1 - P(\omega_2|\rho_1))\,b(\omega_1) + P(\omega_2|\rho_1)b(\omega_2).$$

The expected benefit of the treaty, given a signal of $\rho_2$ (i.e. "Climate change is serious"):

$$E[b|\rho_2] = (1 - P(\omega_2|\rho_2))\,b(\omega_1) + P(\omega_2|\rho_2)b(\omega_2).$$

So the expected benefit is a weighted average, with weight given to $b(\omega_2)$ shown in this figure:



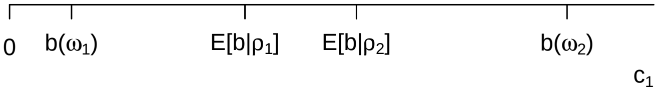
# When does state 1 send a truthful signal?

Assume state 2 "follows the signal" (i.e. signs if state 1 says climate change is serious and not otherwise).

Then state 1 sends a truthful signal if $E[b \mid \rho_2] > c_1$ and $E[b \mid \rho_1] < c_1$, i.e. if $c_1 \in \big(E[b \mid \rho_1], E[b \mid \rho_2]\big)$.

Low scientific uncertainty:


High scientific uncertainty:



# When does state 2 follow the signal (1)?

If it is *certain* that $c_1 \in \left(E[b \mid \rho_1], E[b \mid \rho_2]\right)$, then state 2 follows the signal under the same conditions: i.e. if $c_2 \in \left(E[b \mid \rho_1], E[b \mid \rho_2]\right)$.


If it is *uncertain* whether $c_1 \in \left(E[b \mid \rho_1], E[b \mid \rho_2]\right)$, then conditions become even more restrictive.

# When does state 2 follow the signal (2)?

The expected benefit of the treaty, given state 1 gives message $\mu_1$ (i.e. "Climate change is not that serious"):

$$E[b|\rho_1] = \big(1 - P(\omega_2 \mid \mu_1)\big) b(\omega_1) + P(\omega_2 \mid \mu_1) b(\omega_2).$$

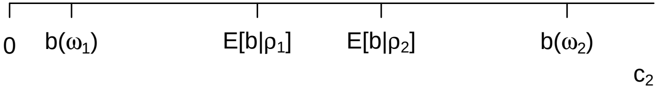
So what is $P(\omega_2 \mid \mu_1)$?

# Bayes' Law and the treaty game

Uncertainty about state 1's type further reduces range of player 2's costs for which truthful equilibrium is possible.

For example, key range when state 1 is certain to be "open-minded" but report may be incorrect:

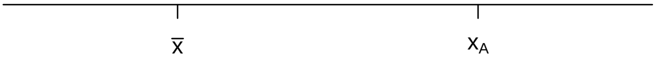

Key range when report may be correct AND state 1 may not be "open-minded":



## Veto threat illustration

# Veto threat setup

Agenda setter $A$ and veto player $B$ have Euclidean preferences on a unidimensional policy space.




Status quo $\overline{x}$ and agenda setter's ideal point $x_A$ common knowledge, but only $B$ knows $x_B$.

Timing of game:

- Veto player $B$ sends message to agenda setter $A$
- Agenda setter proposes policy $x$
- Veto player $B$ accepts or rejects

# Veto threats: analysis

Could there be a truthful equilibrium where *B* tells *A* exactly what $x_B$ is?


- How would *A* choose $x$ in such an equilibrium?
- Given that choice, could *B* do better by lying in any circumstance?

# Veto threats: analysis

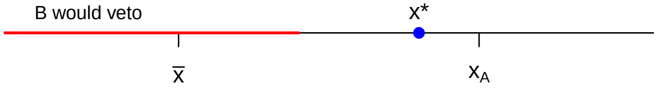
Could there be a truthful equilibrium where $B$ tells $A$ whether she would accept a proposal of $x_A$?


- How would $A$ choose $x$ in such an equilibrium?
- Given that choice, could $B$ do better by lying in any circumstance?

# Veto threats: result

Matthews (1989) shows that there can be only two types of subgame perfect Nash equilibrium, depending on $A$'s beliefs about $B$'s possible types:

**Size one** equilibrium: regardless of the message sent, $A$ proposes some $x^* \in (\overline{x}, x_A)$ based on risk-reward tradeoff




**Size two** equilibrium:

- $B$ announces that $x_B$ is above or below a cutoff $c$
- if above, $A$ proposes $x_A$;
- if below, $A$ proposes some $x^{**}$ based on risk-reward tradeoff