Why are Scientific Forecasts Regarding Climate Change Unable to Trigger its Mitigation?

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A paradox

- For decades, there has been **scientific consensus** on **human responsibility** regarding global warming (IPCC 1988)
- Climate change has been measured as a **major concern** in the general population (Whitmarsh and Capstick 2018)
- Yet, scientific recommendations seem to **lack influence** on public behaviour.
  - → Strong **resistance** against concrete political measures such as carbon pricing (Maestre-Andrés et al. 2019, Douenne and Fabre 2020)

Epistemological failure

This paper offers an explanation for this apparent **paradox** starting from the following assumption:

Climate **predictions** are so **complex** that they are pure expert-based knowledge. Perceived difference in **interest** between experts and laymen may brake this **epistemological** bound of **trust**.

Climate change. How do we know ?

Hardly through **perception**:

→ Slow phenomenon (on a human scale)

→ Global change

→ Noisy evolution

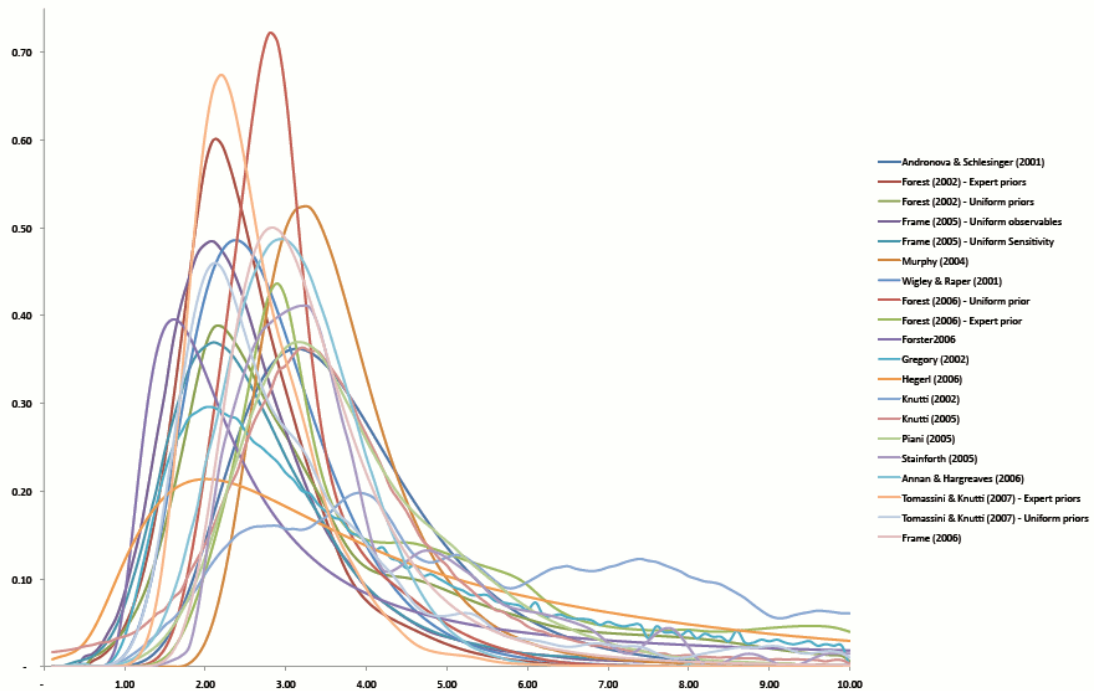
Complex science

- The **theory** explaining the effect of green house gases (GHG) on temperature is well understood
- Yet, precise predictions on the effect of emissions on the temperature is very **complex**
- Uncertainty is even higher is one consider the impact on the **economy** and tries to account for **behavioural responses**

Do we directly **understand** how these predictions are made ?

1. Predictions are mostly based on **black-box** computer simulations.
2. **Multiple** models and predictions are available. How should we choose ?

Model uncertainty



The effect of GHG on climate sensisivity.
Figure taken from Millner et al. (2014)

Expert-based knowledge

How are my beliefs regarding the effects of climate change **justified** ?

→ Not through perception, nor through theoretical understanding.

Climate science is mostly **expert-based**:

→ The **models** underlying these beliefs are provided by experts (that we generally don't know)

→ The **choice** among these models is (at least partially) guided by experts

Can our **trust in experts** alone trigger climate mitigation ?

Epistemic dependence

- Saying we know the effects of climate change but not through **perception** or **logic** implies denying the Kantian imperative of **epistemic independence**
- In doing so and by saying we know about the effects of climate change fully through experts is in line with Hardwig's (1985, 1991) **epistemic dependence**

One can be justified in holding a proposition coming other individuals as knowledge if one is **justified** in believing **those** who support it and that they are **intellectual authorities** on the subject.

A game-theoretical proposal

Are we justified to believe experts **only through** perception or logic (reductionist thesis) ? Or, can an intellectual authority be a **primary source** of knowledge (anti-reductionist thesis) ?

I propose to use the notion of **Nash equilibrium** as a foundation for an anti-reductionist theory of expert-based knowledge

→ A **layman** is entitled to hold a proposition conveyed by an expert for knowledge if, given the resulting actions of the layman, this **expert has no interest** in conveying another proposition.

Empirical evidence

Why are scientific forecasts regarding climate change unable to trigger its mitigation ? The empirical answer:

- **Free-riding**: the most common explanation captured by surveys for resistance against strong climate policies (Fischer et al. 2011)
- **Complexity**: Sterman (2008) showed how hard it is to draw a causal link between the multiple potential causes of climate change and their consequences, even for MIT students
- **Normative disagreements**: Ehret et al. (2018) provides evidence on how distrust for climate science can emerge from political partisanship, distributional concerns or other normative aspects

The model will captures all three aspects

Contribution to a public bad

1. In this paper I model GHG emissions as a game of contribution to a **public bad**

   → Contributors **benefit** from GHG emissions → consumption goods
   → Contributors **suffer** from the total GHG emission level because of potential climate damage

2. There is **uncertainty** on the exact climate damages for a given level of emission.

3. **Free-riding effect:** Contributors don't take other's benefit into account

Scientific authority

- Prior to acting, contributors receive advice on climate risk from an **expert**
- Because of **complexity**, expert is the **only source** of knowledge: full expert based
- There is a **normative misalignment**:
  - → The expert is utilitarian and aims for **social welfare**.
  - → His preferred level of GHG emission $<$ non-cooperative equilibrium

→ **Cheap-talk game** between the scientific authority (sender) and multiple contributors to a public bad (receivers)

Main result: information transmission failure

→ At equilibrium, **no information** can be conveyed by the scientific authority

→ The expert is not strategically **credible** and thus not a **reliable** source of knowledge because he always has an interest for **exaggerating** climate risk

→ The strength of the **theoretical** analysis is to reveal that, because of the strategic setting, even **truthful claims** will be perceived as non-credible by her audience.

Receivers

- One sender S and N receivers R_i having to choose a level of GHG emissions $e_i \geq 0$.
- Uncertainty on the severity of climate damages: $\Omega = [a, b]$
- Receiver i's utility function will be:

$$u_i(e_i, e_{-i}, \omega) = e_i - \frac{\omega}{\beta} \sum_{i=1}^{N} e_i^{\beta}$$

where $\beta > 1$ parametrises the severity of climate damage

Sender

The sender is utilitarian and seeks to maximise social welfare. That is:

$$u_S(e_1, ..., e_N, \omega) = \sum_{i=1}^{N} u_i(e_i, e_{-i}, \omega)$$

Timing

1. Nature draws the state $\omega_0 \in [a, b]$ according to a uniform distribution
2. S is privately informed of the state
3. **Communication stage:** the sender sends a message m to the receivers regarding its type
4. **Emission stage:** the receivers choose simultaneously a level of GHG emissions e_i

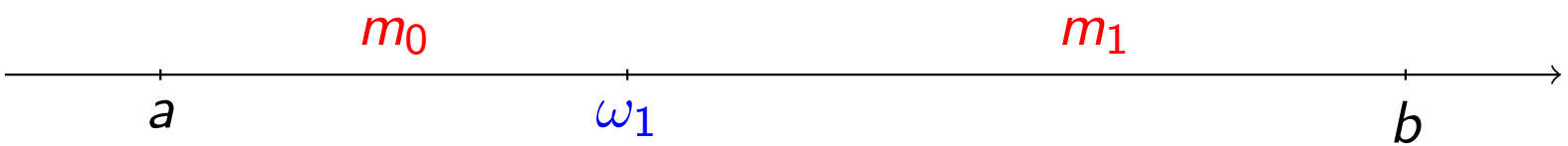
Misalignment

- For any given message m, the equilibrium GHG emission level of a receiver is $e(m)$
- The socially optimal GHG emission level of a receiver is $e^W(m)$
- We have that $e^W(m) < e(m)$. The higher N the bigger the difference

Partitional equilibrium

Proposition 1

There can only be a finite number of equilibria in the communication stage. All of them are partitional.



$\rightarrow$ Information is **diluted**. For ω_1 to be a cut-off it must be that S is **indifferent** between messages m_0 and m_1.

No communication in large societies

Theorem 1

For $\beta > 1$, if $N \geq \frac{1}{2}(1 + \frac{b}{a})$, then no information transmission is possible at equilibrium.

- The **normative misalignment** is **too important**: for any $\omega \in \Omega$, $e(m_1) > e(m_0) > e^W(\omega)$
- **Support** dependent result:
  - $\rightarrow$ If there is a strictly positive probability that **damage is low** ($a \rightarrow 0$), even with $N = 2$, information transmission is impossible.
  - $\rightarrow$ If the support for receiver's belief is **wide** ($b >> a$), then N must be larger for information transmission to be impossible.

No communication in small societies

Theorem 2

When $\beta \leq 2$, for $N \geq 2$, no information transmission can happen at equilibrium.

- Below quadratic level damages are **too low** to trigger sufficiently **moderated** emission levels to meet the sender's credibility constraint, even when N is small.

A second Tragedy of the Commons

- The tragedy of the commons (Lloyd 1833): in **public good games**, because individuals don't account for the side effects of their actions on others (externalities) the good is **under-provided** leading to a **socially dominated** situation.
- A form of paradox: despite the normative difference between the expert view and the decentralised outcome, **on average**, the expert would still be **better off** if the contributors had the **same knowledge** as him.

  → The **normative preferences** of the experts on outcomes are responsible for his **failure** as source of knowledge **and** detrimental for welfare.

Sum-up

- This paper offers a theoretical construction to explain why despite **high concerns** regarding climate change, there is **limited support** for strong regulations
- I assume that for laypeople, climate knowledge is entirely **expert-based**
- I propose to use the **Nash equilibrium** as a tool to measure how much knowledge we are justified to hold when provided by experts with whom we hold **normative differences**
- Building on **empirical evidence** I showed that free-riding behaviour, climate science complexity and normative differences create a **strategic environment** responsible for this paradox