Living with uncertainty

Alexei Grinbaum
CEA-Larsim

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Living with uncertainty: from the precautionary principle to the methodology of ongoing normative assessment

Jean-Pierre Dupuy, Alexei Grinbaum*

CREA, École polytechnique, 1, rue Descartes, 75005 Paris, France

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Alexei Grinbaum and Jean-Pierre Dupuy,

"Living with Uncertainty: Toward the Ongoing Normative Assessment of Nanotechnology"

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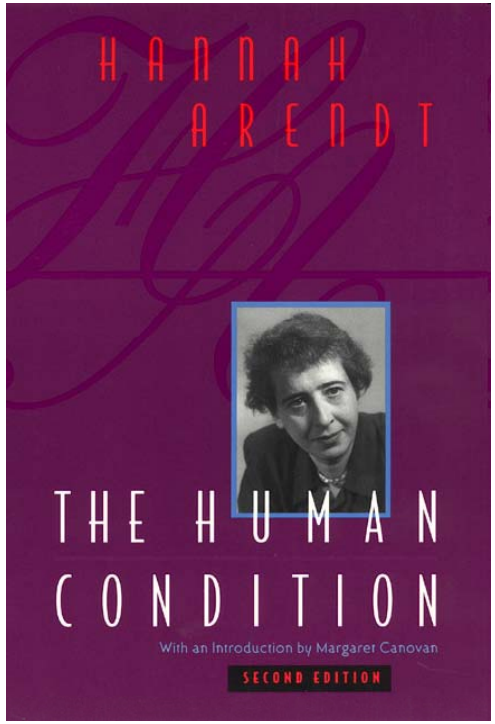
Uncertainty



"Processes are started whose outcome is unpredictable, so that **uncertainty rather than frailty becomes the decisive character of human affairs**"

Risk: we know both the probabilities of possible harmful events, and their associated kinds and levels of damage.

Uncertainty: we know the types and scales of possible harms, but not their probabilities.

Ambiguity: measurement, characterization aggregation or meanings of the different issues are themselves unclear.

Ignorance: we don't have complete knowledge over all the possible forms of harm themselves. We 'don't know what we don't know' – facing the possibility of surprise.

Indeterminacy: the possibilities for different social 'framings' depend 'reflexively' on complex interactions and path dependencies in the co-evolution of social, technological and natural systems.

Jamais on n'a appris
ni entendu dire,
et jamais l'oeil n'a vu…

Isaïe 64:4

Ce sont des choses que l’oeil n’a point vues, que l’oreille n’a point entendues, et qui ne sont point montées au cœur de l’homme…

1 Corinthiens 2:9

Approche standard:

- axiomes de Savage pour les probabilités subjectives
- la règle de Bayes pour leur mise-à-jour

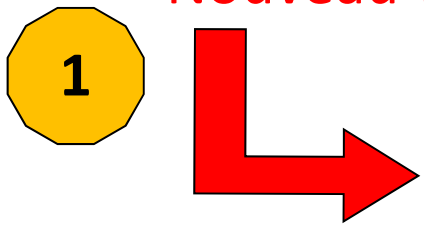
Toute incertitude est épistémique,

c'est-à-dire, associée avec l'état imparfait de connaissance du sujet

Le principe de précaution distingue entre le risque « connu » et le risque « potentiel » :

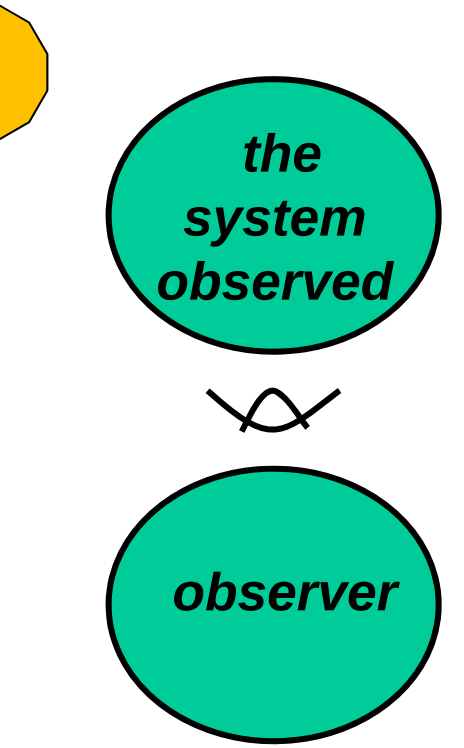
pour le Bayesien, il n'y a pas de différence

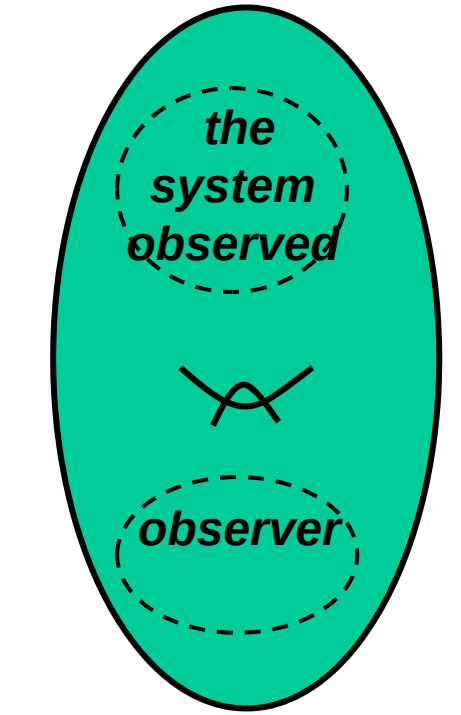
Nouveau ?



Les événements que l'on considère sont des *événements uniques*

2


the system observed
observer
time


the system observed
observer
time

Society is a participant

- **Society at large is not an external observer**

Breuer's theorem:

An internal observer can only have limited information about the state of the system [that he observes from within]

Principe inverse de l'évaluation des risques

3

La propension de la communauté de reconnaître l'existence d'un risque dépend du degré de croyance de cette communauté en l'existence des solutions.

D. Fleming

Barrières cognitives:

- Effet de certitude
- Aversion à la non-connaissance
- Impossibilité de croire

Origin of cognitive barriers:

The way a decision problem is "framed" (described) has a huge influence on the way people solve it.

Amos Tversky and Daniel Kahneman

The certainty effect

Problem 1: Choose the option you prefer:

- a sure win of $30
- 80% chance to win $45

The certainty effect

- **Problem 1**: Choose the option you prefer:
  - a sure win of $30 **[78%]**
  - 80% chance to win $45 **[22%]**

Problem 1: Choose the option you prefer:

- a sure win of $30 **[78%]**
- 80% chance to win $45 **[22%]**

Problem 2: Consider the following two-stage game. In the first stage, there is a 75% chance to end the game without winning anything, and a 25% chance to move into the second stage. If you reach the second stage you have a choice between:

- a sure win of $30
- 80% chance to win $45

Your choice must be made before the game starts. Choose the option you prefer.

Problem 1: Choose the option you prefer:

- a sure win of $30 **[78%]**
- 80% chance to win $45 **[22%]**

Problem 2: Consider the following two-stage game. In the first stage, there is a 75% chance to end the game without winning anything, and a 25% chance to move into the second stage. If you reach the second stage you have a choice between:

- a sure win of $30 **[74%]**
- 80% chance to win $45 **[26%]**

Your choice must be made before the game starts. Choose the option you prefer.

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- a sure win of $30 **[74%]**
- 80% chance to win $45 **[26%]**

Your choice must be made before the game starts. Choose the option you prefer.

Problem 3: Choose the option you prefer:

- 25% chance to win $30
- 20% chance to win $45

Problem 1: Choose the option you prefer:

- a sure win of $30 **[78%]**
- 80% chance to win $45 **[22%]**

Problem 2: Consider the following two-stage game. In the first stage, there is a 75% chance to end the game without winning anything, and a 25% chance to move into the second stage. If you reach the second stage you have a choice between:

- a sure win of $30 **[74%]**
- 80% chance to win $45 **[26%]**

Your choice must be made before the game starts. Choose the option you prefer.

Problem 3: Choose the option you prefer:

- 25% chance to win $30 **[42%]**
- 20% chance to win $45 **[58%]**

Compare 1 and 3

Problem 1: Choose the option you prefer:

- a sure win of $30 **[78%]**
- 80% chance to win $45 **[22%]**

Problem 3: Choose the option you prefer:

- 25% chance to win $30 **[42%]**
- 20% chance to win $45 **[58%]**

Certainty exaggerates the aversiveness of losses that are *certain* relative to losses that are merely *possible* – the certainty effect

Compare 2 and 3

Problem 2: Consider the following two-stage game. In the first stage, there is a 75% chance to end the game without winning anything, and a 25% chance to move into the second stage. If you reach the second stage you have a choice between:

- a sure win of $30 **[74%]**
- 80% chance to win $45 **[26%]**

Problem 3: Choose the option you prefer:

- 25% chance to win $30 **[42%]**
- 20% chance to win $45 **[58%]**

Certainty in 2 is illusory as the gain is contingent upon reaching the second stage of the game. This is a pseudo-certainty effect or the effect of contingent certainty.

Contingently certain outcomes play a fundamental role:

climate change example

"Economic development shouldn't be sacrificed for the sake of environment": in case of an impending major climatic disaster, a strong economy would constitute a sure asset to fight its harmful consequences.

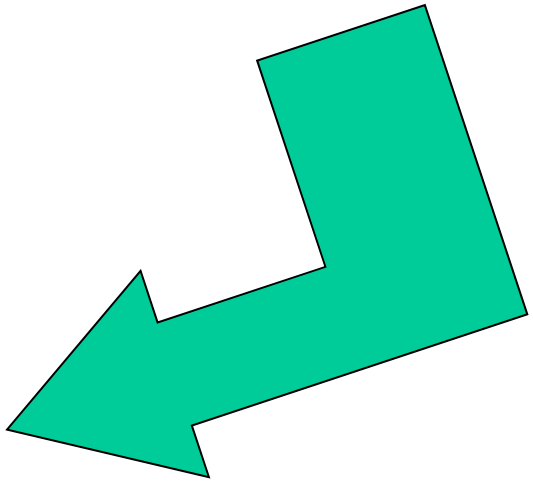
Hence a "no-regret" strategy: never consent to an expenditure in the name of the environment that you might have a chance to regret if it turns out that it had been made in vain.

On the other hand, strengthening the industrial economy increases the probability of a major ecological disaster.

It is likely that contingent certainty will win against mere probability, because of the superiority of contingent certainty over probability.

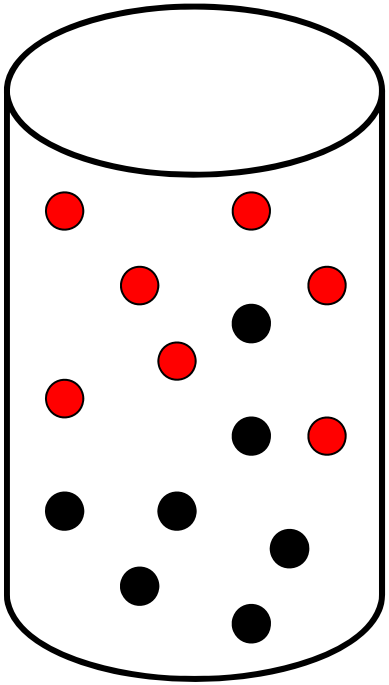
Cognitive barriers:

- The certainty effect
- Aversion to not knowing
- Impossibility of believing

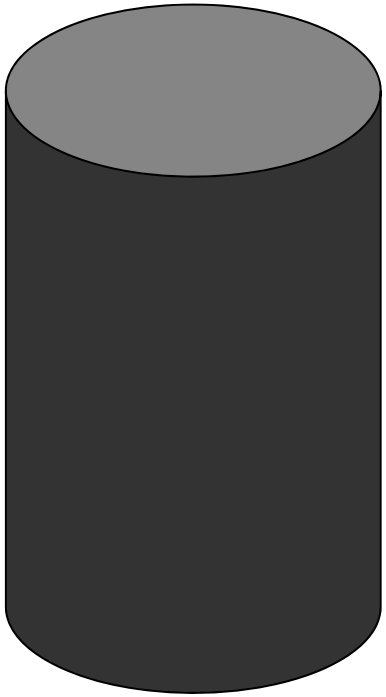


The Ellsberg Paradox

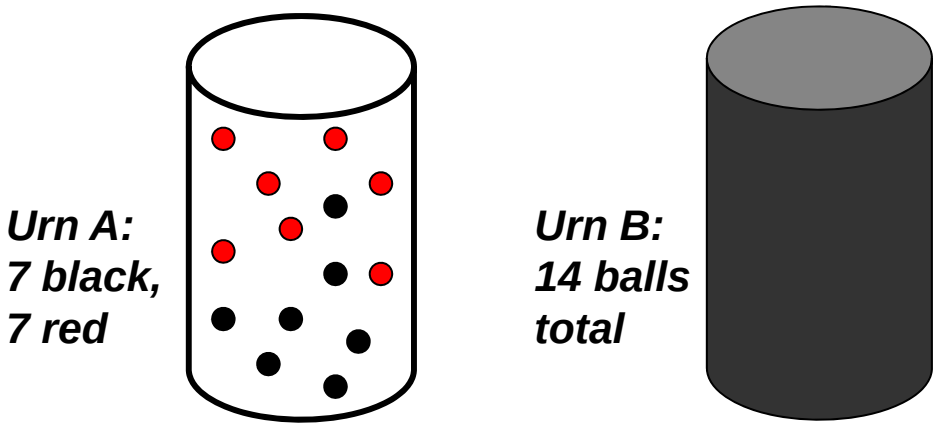
Urn A:
7 black,
7 red



Urn B:
14 balls
total



Choose one urn and then bet on the color of the ball that is drawn



Choose one urn and then bet on the color of the ball that is drawn

Probabilistic decision using Savage's axioms:
choose urn B

Ellsberg's result:
strong practical preference for urn A

Why urn A? Because the probability is known in advance.

Lessons of the Ellsberg Paradox

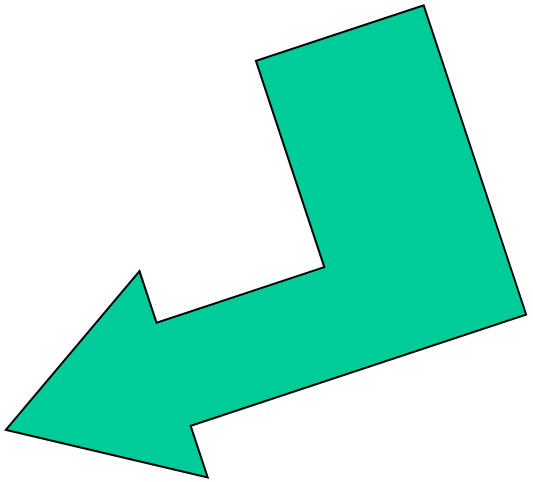
- **Human decision makers are not probability calculators**

- **Aversion to not knowing means that one prefers to have some information rather than no information. This information can be bad, unreliable, non-optimal, etc. – it does not modify the preference**

- **This can only be overcome if agents are forced to think deliberately about the rules and conditions of their decision making. It means that the agent has to analyze in real time his or her own actions.**

Cognitive barriers:

- The certainty effect
- Aversion to not knowing
- Impossibility of believing



Impossibility of believing

- The obstacle is not just uncertainty, scientific or otherwise. Action is initiated by belief, and not by knowledge.

- In case of a dramatic future event, we witness an impossibility of believing that the worst is going to occur.

- One can know that P but still not believe in P.

“However, the reason for increasing damages in spite of timely forecasts lies not in forecasting and warning technology, but elsewhere… there is a distinct attitude of indifference towards the warnings.”

Source: A. Sharma “Communication strategies for floods risk reduction in Yamuna river-bed squatters”

“How did so many people get caught by surprise by Ruiz’s catastrophic lahars, in spite of accurate risk assessments and intensive efforts at public education?”

Source: “The Eruption of Nevado Del Ruiz Volcano, Colombia, November 13, 1985”, US Commission on Engineering and Technical Systems.

Paralysis in decion-making

Absence of information + singular character of a future event entail:

a) If there is a possibility not to act, then agent does not act (*cognitive paralysis*).
b) If agent is forced to act, then effects appear due to aversion to not knowing.
c) Agent will do his best to acquire information, however bad or unreliable it may be.

A few lessons

- Human decision makers are not probability calculators

- One prefers some information to no information. That this information may be bad, unreliable or non-optimal does not modify the preference.

- This can only be overcome if agents are forced to analyze their own actions in real time ("agents are also meta-agents").

Practical steps

- What do people hear and see?
  - ✓ PDFs.
- How do people react?
  - – “Give us a list of positives and negatives.”
  - – Establish spontaneous grounds for suspicion and concern.

1. **What do scientists say?**
2. **What do people hear?**
3. **How do people react?**