Scientific Uncertainty and Disagreement

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Uncertainty and disagreement: uniformly bad?

Cartesian conception of knowledge: single individual in pursuit of absolute certainty.

Against this background, uncertainty and disagreement lead to distrust in science: you don't get what you pursue.

In a democracy, distrust in science is problematic: we need voters and politicians to make informed decisions.

Our contrasting view: uncertainty and disagreement are byproducts of something good, though do pose challenges.

A more realistic conception of science should allow for uncertainty and disagreement

- Science makes bold hypotheses about phenomena that are immensely complex or remote from us. We extend our reach—at the cost of introducing some uncertainty.

- Science is a collaborative, highly self-critical undertaking. Again, we extend our reach—at the cost of introducing some disagreement.

Yet—uncertainty and disagreement pose challenges and need to be managed.

Two distinct but related challenges

1. How should (non-scientific) decision-makers handle uncertainty and disagreement in science?

- Policy-makers
- Consumers
- Voters

2. How should scientists themselves handle uncertainty and disagreement in science?

- Decision-making in science
- Intra-scientific testimony
- Public scientific testimony

How should decision-makers handle uncertainty and disagreement?

We want important decisions to be based on sound knowledge.

So decision-makers consult experts, who are often scientists.

This poses a challenge for decision-makers: how to handle uncertainty and disagreement?

Thesis: Responsible decisions do not require certainty or unanimity.

The case of uncertainty

Decision theory: maximize expected value:

$$\sum \text{value(outcome)} \times \text{probability(outcome)}$$

Precautionary principle: pay special attention to the worst outcomes!
(Example: 100% chance of value 5 vs. 95% change of value 6 and 5% chance of -10.)

But–decision theory and PP appear to conflict! And if so, PP gives no clear advice.

RQ (research question): What does, and should, PP say?
- Revise decision theory
- Methodological injunction to think extra hard about the worst potential outcomes
- Maximize, not the plain value of the outcomes, but their "ethical value"

The case of disagreement

When scientists disagree, on what grounds should non-scientists make decisions?

- **Picking:** Pick a single scientist (but who?) and ignore the rest (but why?).
- **Aggregation:** Aggregate individual judgments into a single group judgment.
- **Consensus:** Wait for a consensus to form – or force it, e.g. with a 'consensus conference'.
- **Divide et impera:** Ascertain the source of the disagreement, and respond to it accordingly...

Sources of scientific disagreement

RQ: What are the different possible sources of scientific disagreements?

1. Scrutiny: The self-critical and competitive nature of the research means that every view is subject to intense scrutiny ('organized skepticism').
2. Pluralism: A plurality of scientific methods, approaches, and background views leads different researchers to different conclusions.
3. Values: Different extra-scientific values and/or worldviews lead different groups to different conclusions.
4. Grouping: Social grouping effects, e.g. belief polarization, information cascades, and various biases, create or magnify disagreements.
5. Manufacturing: Disagreement is manufactured by outside actors, e.g. with industry-funded research that is selectively shared.

The good, the bad, and the unsettled

The good: Disagreements due to Scrutiny or Pluralism would indicate that scientists' (individual/aggregated/consensus) judgments are generally trustworthy.

The bad: Disagreements due to Grouping or Manufacturing would indicate that the scientists' judgments are generally untrustworthy.

The unsettled: Disagreement due to Values would indicate that scientists' judgments depend on extra-scientific values or worldviews.

- Problematic, in so far as we want or expect a completely 'objective' (value-free) decision-making process.
- Unproblematic, in so far as we want or expect a plurality of values and worldviews to be represented in the decision-making process.

Diagnosing and managing disagreements

RQ: How can decision-makers detect the source of disagreement in a given case, separating the good from the bad (and the unsettled)?

- Example: Might the presence of disagreements on related issues, or the extent of (dis)agreement itself, help to indicate that the source is Scrutiny or Pluralism?

RQ: How should decision-makers deal with problematic sources of disagreement when they (are likely to) arise in practice?

- Example: How can expert committees be composed and be made to work in such a way as to manage Values while counteracting Grouping and Manufacturing?

Two distinct but related challenges (again)

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Scientists handling uncertainty and disagreement [1/2]

Familiar questions regarding how scientists should handle uncertainty have less familiar analogues for disagreement; for example:

- Q: How should scientists communicate uncertain claims to their peers, policy makers, and the public?
  - E.g.: Familiar debate about whether non-scientific values will or should influence scientists' testimony and advice.
- RQ: How should scientists communicate contested claims to their peers, policy makers, and the public?
  - E.g.: Should scientists communicate their own views on contested claims, or those of the majority, some combination of both, or something else?

Scientists handling uncertainty and disagreement [2/2]

Familiar questions regarding how scientists should handle uncertainty have less familiar analogues for disagreement; for example:

- Q: How should scientists update their attitudes to theories upon learning something that is uncertain?
  - E.g.: Classic debate about whether probabilistic updating should use Bayesian or Jeffrey Conditionalization.
- RQ: How should scientists update their attitudes to theories upon learning something that is contested?
  - E.g.: Should scientists ignore the attitudes of other scientists (≈steadfastness), adopt an average of those attitudes (≈conciliationism), do some combination of both, or something else entirely?

Concluding summary

Uncertainty and disagreement are inevitable byproducts of something good: science extends its reach by being daring and collaborative.

But uncertainty and disagreement cause–and are actively exploited to produce– distrust in science, which is pernicious in a democracy.

How to limit these pernicious effects?
- A more realistic conception of science
- How "consumers" of science can manage uncertainty (decision theory, PP) …
- … and manage disagreement (aggregation, consensus, divide et impera)
- The analogous questions for "producers" of science (communicating, updating)