

Expert Judgement and Societal Decision Making in a Web-Connected World.

Simon French

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Societal risk decisions

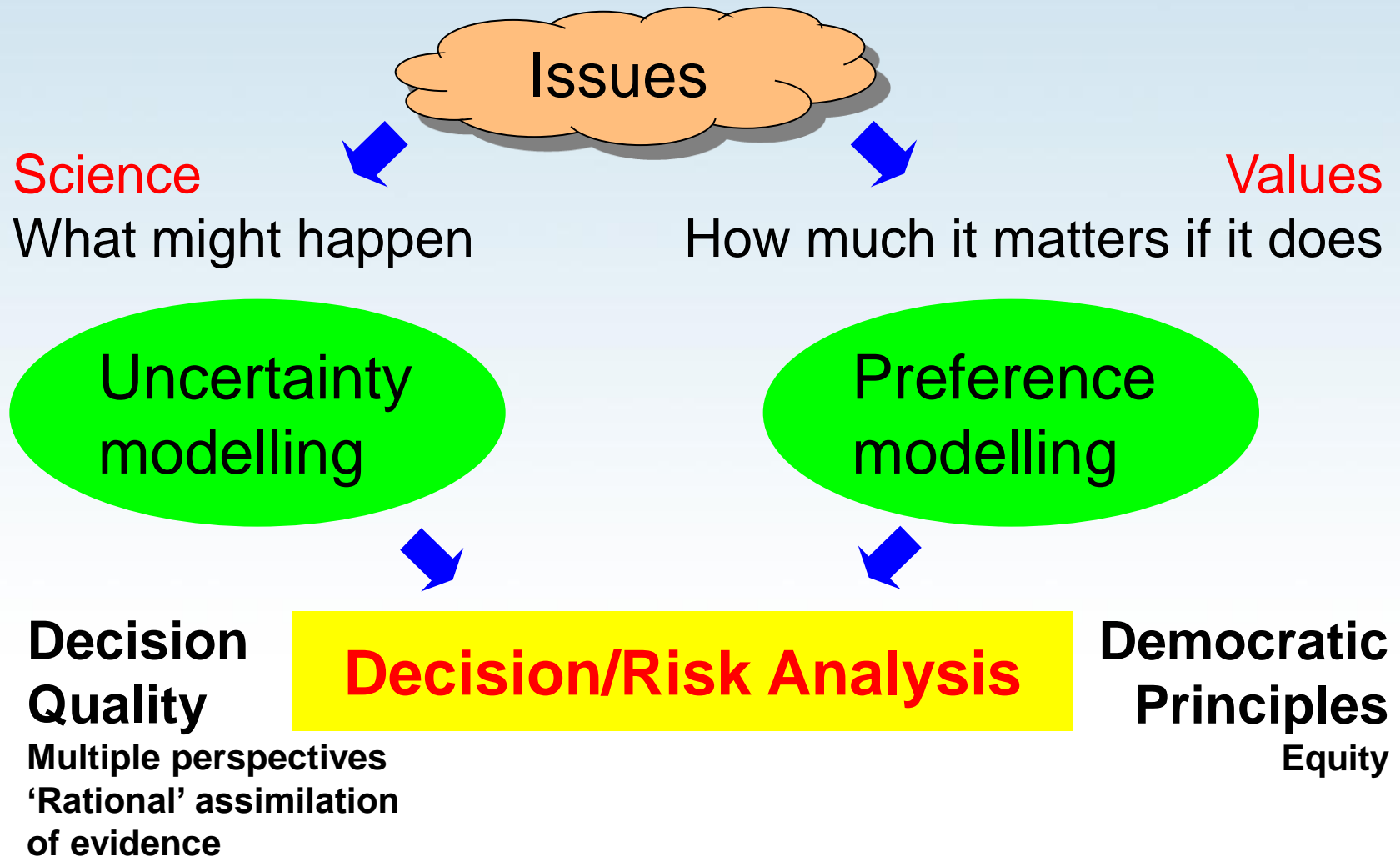
Old way:

Decide → Announce → Defend

New way:

Involve stakeholders and public in deliberations from formulation to decision and implementation

Societal Decisions



The world is becoming more complex

So we need to rely more on expert judgement than on data

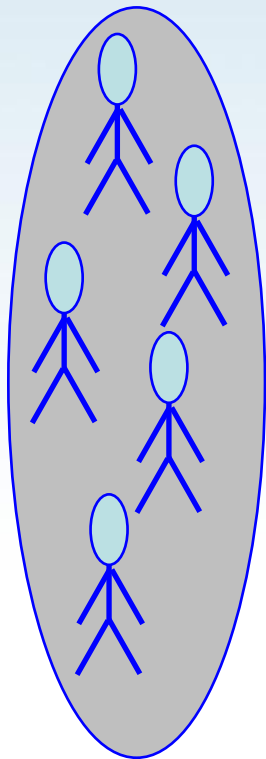
Group Consensus Probability Distributions

Bayesian Statistics 2, Valencia 1983

The Expert Problem

The Group Decision Problem

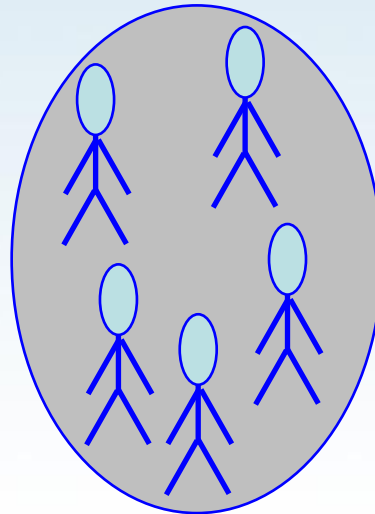
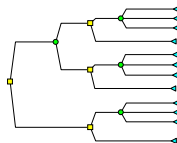
The Text-Book Problem



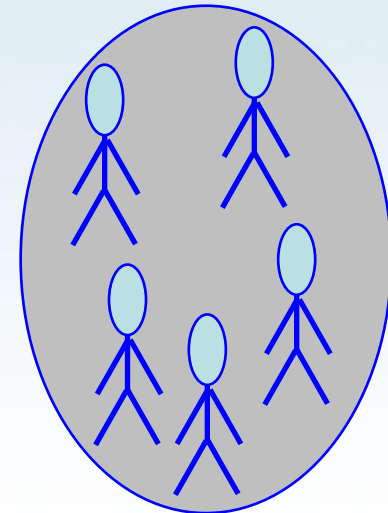
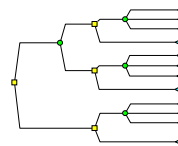
Experts



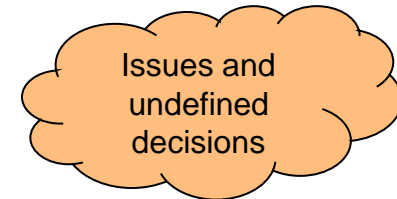
Decision
Maker



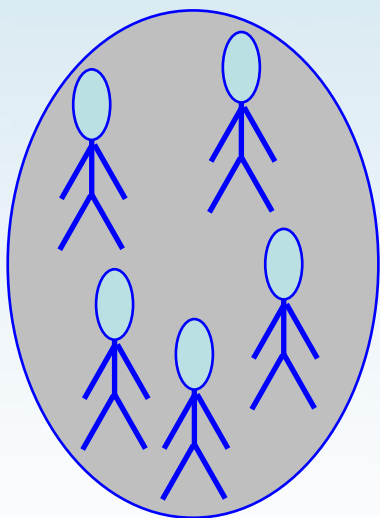
Group of
decision makers



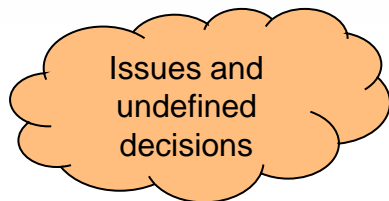
Group of experts



The Textbook Problem

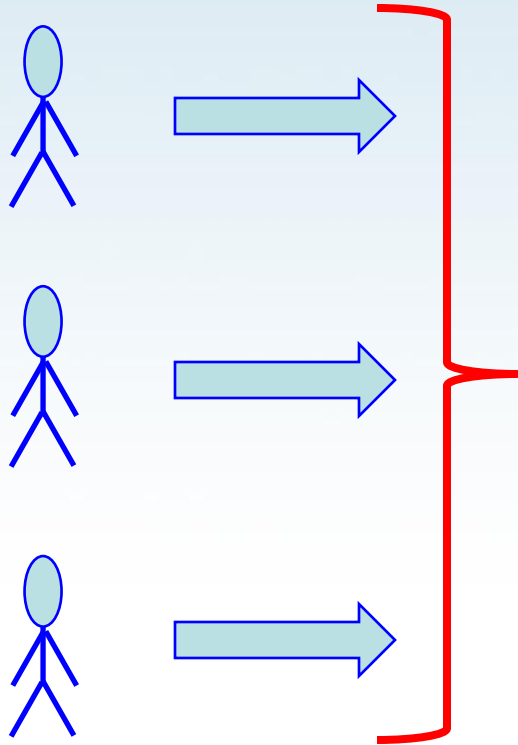


Group of experts



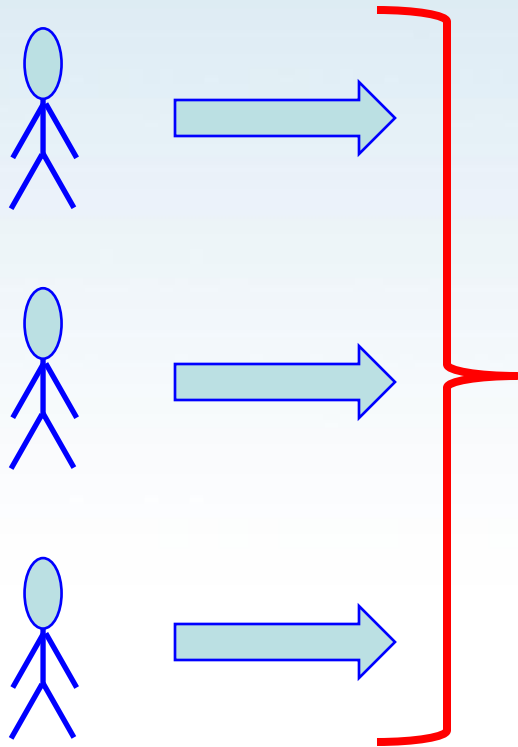
- How to present results to help in future as yet unspecified decisions
 - e.g. Asteroid impact
- How does one report with that in mind?
- Public participation and the web means that many stakeholders are seeking and using expert reports ... **whether or not they understand them**
 - Behavioural issues
 - Probabilities versus frequencies (Gigerenzer)
 - Risk communication
 - Celebrity

Communication issues: What the experts say

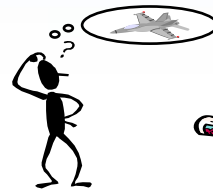


- The experts *broadcast* their views rather than respond to questions of (unknown) decision makers
- Experts are human
⇒ Subject to 'psychological biases'

Communication issues: What the experts say



- The experts *broadcast* their views rather than respond to questions of (unknown) decision makers
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 - ⇒ Subject to 'psychological biases'
- e.g. The availability heuristic



Imaginable



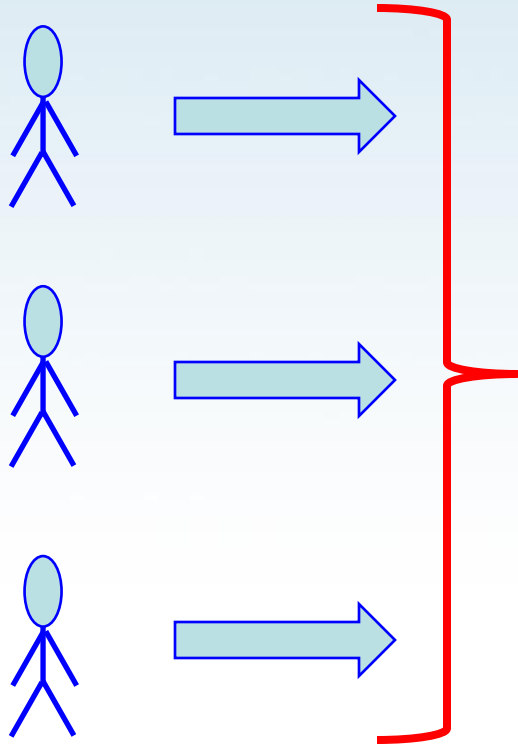
Recent



Dramatic

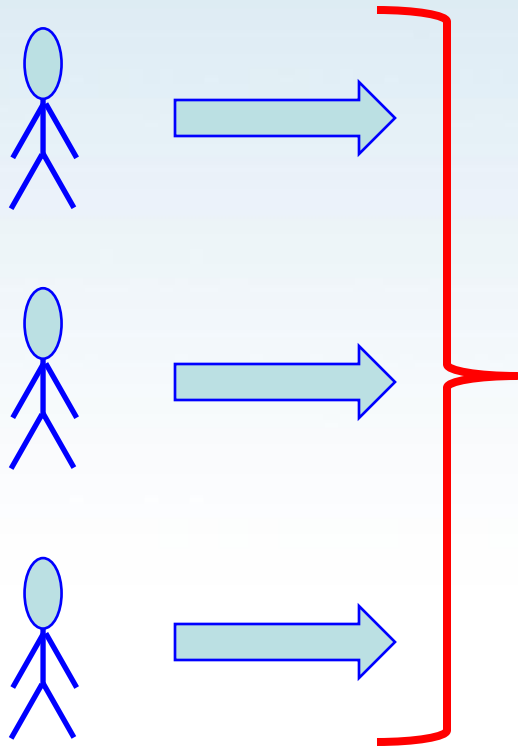
⇒ Bias & poor calibration

Communication issues: What the experts say



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- Such biases *may* be avoided/reduced by careful elicitation protocols..

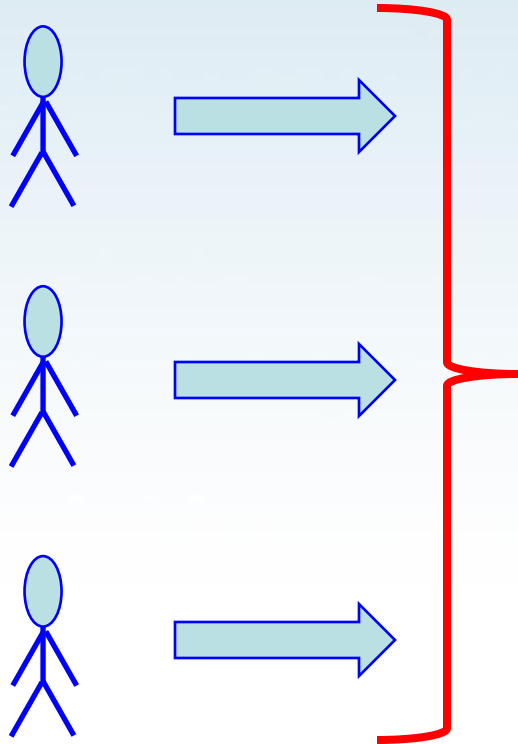
Communication issues: What the experts say



- The experts *broadcast* their views rather than respond to questions of (unknown) decision makers
- Experts are human
 - ⇒ Subject to ‘psychological biases’
- Such biases *may* be avoided/reduced by careful elicitation protocols.
- But experts are also correlated
 - Common science base
 - Similar education
 - Similar experiences

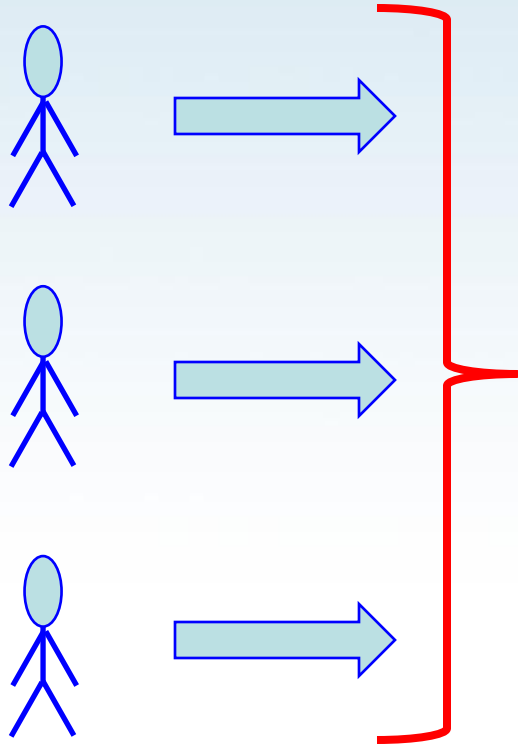


Communication issues: What the experts say



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- Framing issues in what to communicate

Communication issues: What the experts say

- The experts *broadcast* their views rather



Imagine that you are a public health official and that an influenza epidemic is expected. Without any action it is expected to lead to 600 deaths.



However, there are two vaccination programmes that you may implement:

- Programme A would use an established vaccine which would lead to 400 of the population dying.
- Programme B would use a new vaccine which might be effective. There is a 1/3rd chance of no deaths and 2/3rds chance of 600 deaths.



- Framing issues in what to communicate

Communication issues: What the experts say

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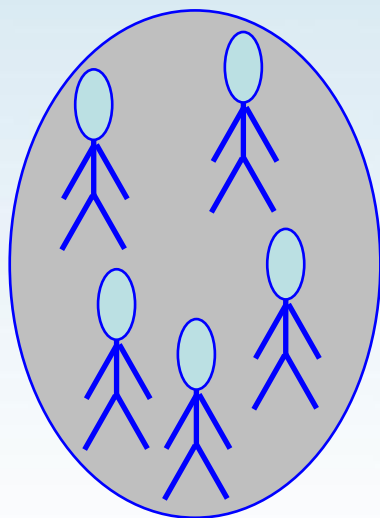
- Programme A would use an established vaccine which would save 200 of the population.
- Programme B would use a new vaccine which might be effective. There is a 1/3rd chance of saving 600 and 2/3rds chance of saving none.



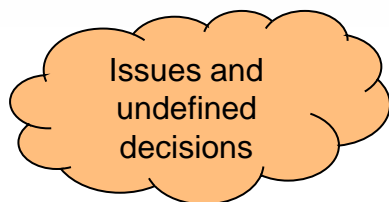
- Framing issues in what to communicate

The Textbook Problem

What questions do we ask

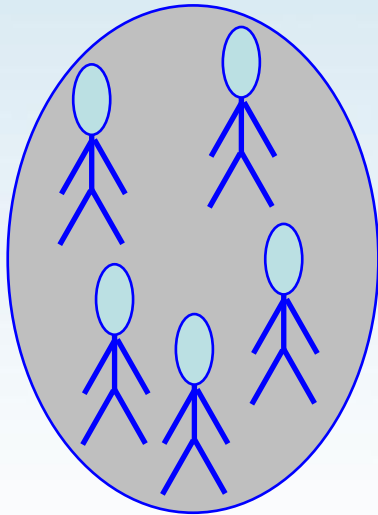


Group of experts

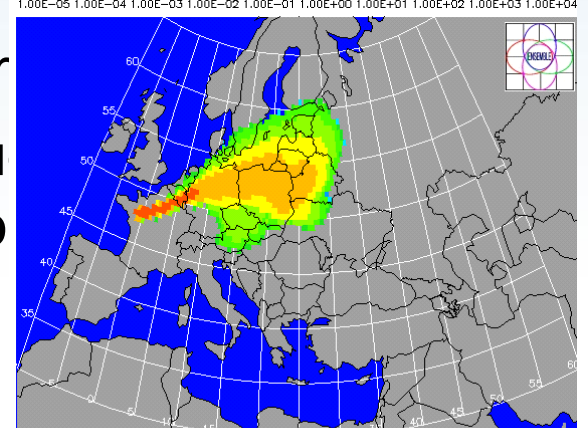
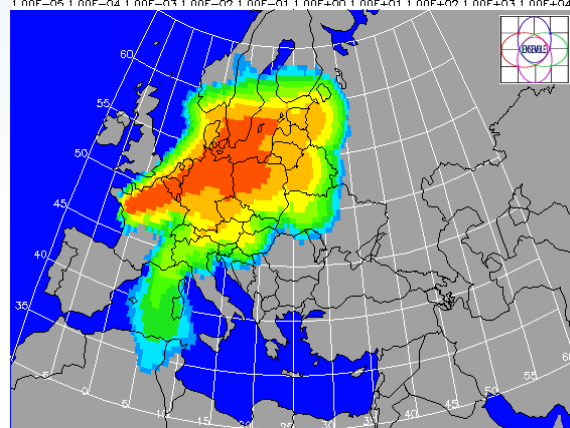
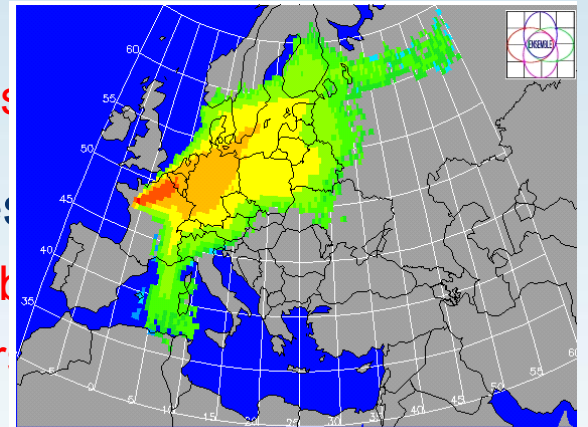
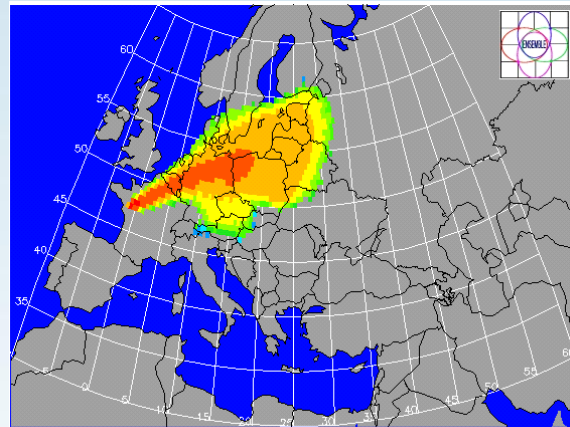
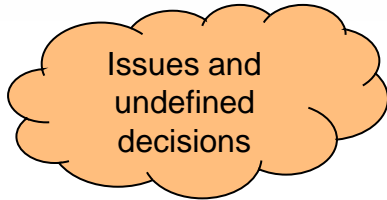


- Ask for observables
 - Must be observable for calibration
 - Model parameters are model dependent
- Actually often ask for:
(expert judgement \otimes model)
- CEC/USNRG study on accident consequence modelling
- ENSEMBLE

The Textbook Problem

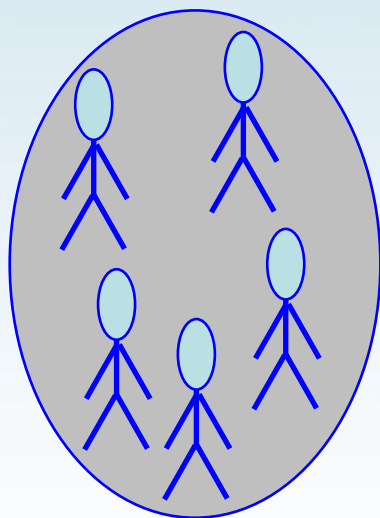


Group of experts

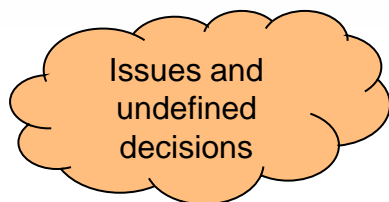


The Textbook Problem

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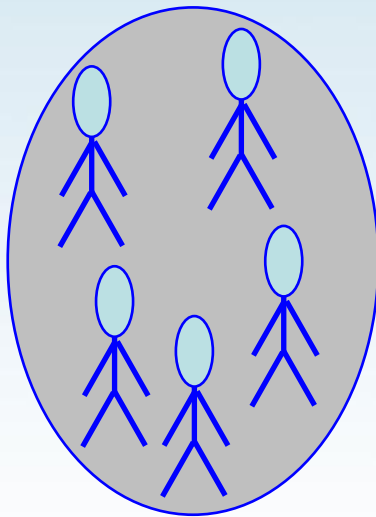
Group of experts



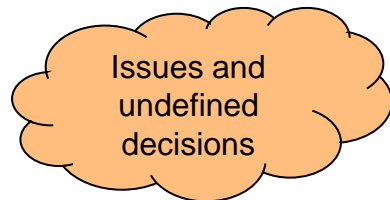
- Ask for observables
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- Actually often ask for:
(expert judgement \otimes model)
- CEC/USNRG study on accident consequence modelling
- ENSEMBLE
- Pragmatic solution:
Treat as expert judgement
e.g. apply Cooke's method

The Textbook Problem: how to report

Cooke's Principles



Group of experts

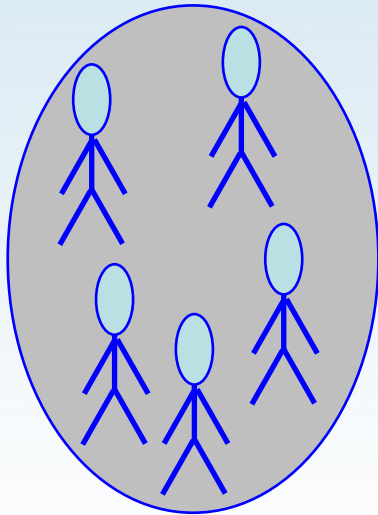


- **Empirical control:** Quantitative expert assessments are subjected to empirical
- Experts are prejudged. They are accepted as expert. experts to state their own opinions, and must not bias results.
- **Fairness:** Experts are not pre-judged, prior to processing the results of their assessments.
- **Scrutability/accountability:** All data, including experts' names and assessments, and all processing to date are open to peer

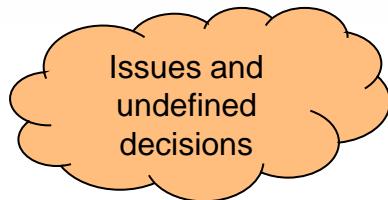


Few reports satisfy this.
Chatham House reporting

The Textbook Problem



Group of experts



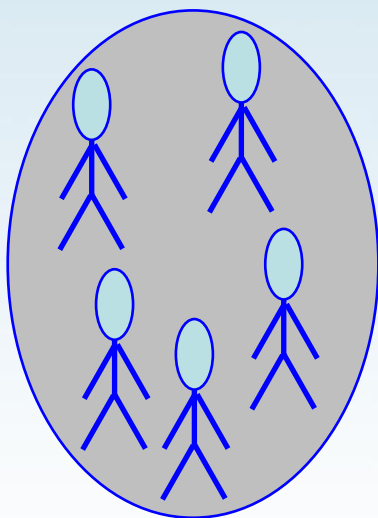
- Exploring issues, formulating decision problems, developing prior distributions
- Since the precise decision problem is not known at the time of the expert studies, the reports will be used to build the prior distributions not update them
- So report should anticipate meta-analyses

The Textbook Problem

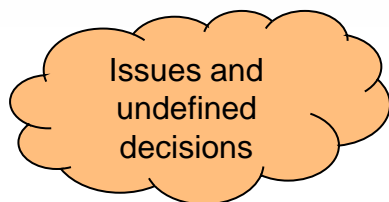
Meta-Analysis

- Goes back to Karl Pearson
- Glass (1976) brought into statistical mainstream
- Cochrane Collaboration and Evidence-Based Medicine
- Focused on systematic review of empirical studies
- Regression/linear model based

The Textbook Problem

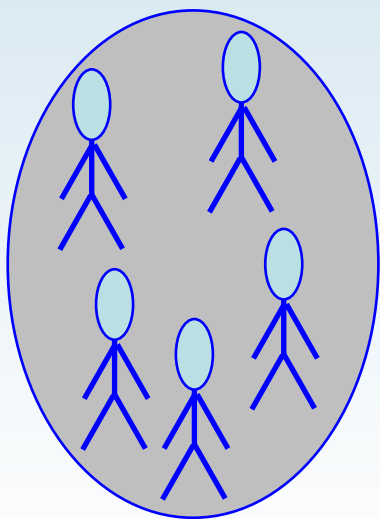


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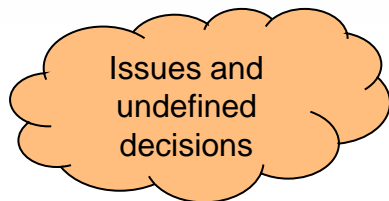


- Exploring issues, formulating decision problems, developing prior distributions
- Since the precise decision problem is not known at the time of the expert studies, the reports will be used to build the prior distributions not update them
- So report should anticipate meta-analyses
 - Report individual judgements
 - Provide calibration data, expert biographies, background information, etc.

The Textbook Problem



Group of experts



Need meta-analytic approaches for expert judgement

- Little peer-review
- Less publication bias, but more context bias
- 'self' promotion' of reports by pressure groups
- Cooke's principles seldom considered
- Independent experiments vs correlated experts
- Experimental Design vs Elicitation Protocol

'Case study': Asteroid impact

- What are the chances of a major asteroid impact that ends humanity?
- What can I as a 'layman' find out from the web on this?
- Note that while astronomers/planetary have a few data, they must be using expert judgment to answer it.

RISK SCALE

RISKY SPORTS

RISKS AND BENEFITS

ASTEROID IMPACT

HAZARD OF AN ASTEROID IMPACT

PROBABILITY OF AN ASTEROID IMPACT

ASTEROIDS - FAQ

RISK TO LIFE ON EARTH

FIREWORKS - WORTH THE RISK?

REDUCING RISKS

HAZARDS FROM PM10'S

CERAMIC FILTERS REDUCE RISKS FROM PM10'S

RISKY EXPERIMENTS

ASTEROID IMPACT

Probability of an Asteroid Impact

The largest asteroids will cause the most damage but there are less of them. Astronomers have used mathematical models and historical data to estimate the probability of an asteroid hitting the earth.

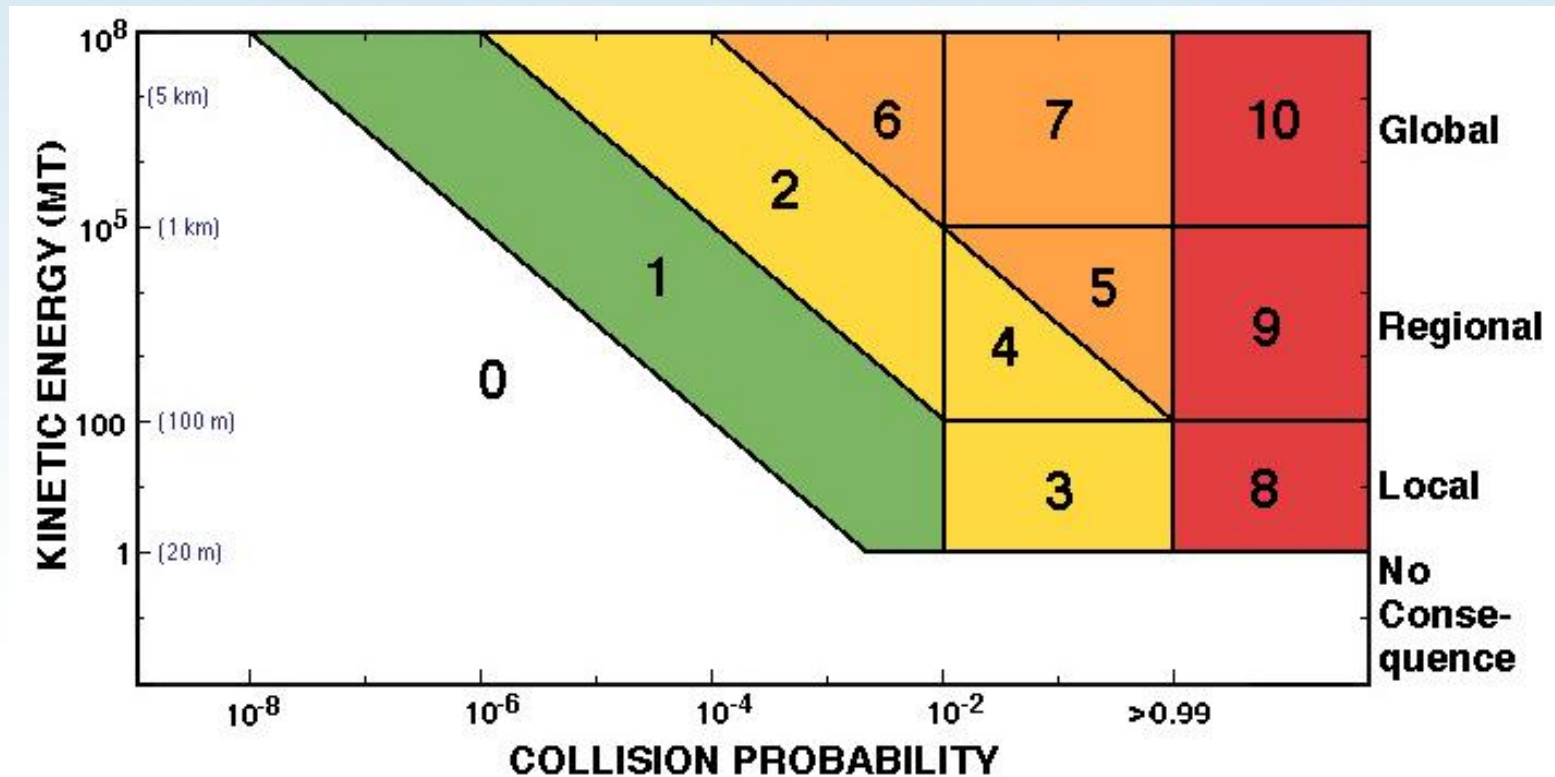
Size	Number near Earth	Frequency of impacts	Last impact	Annual probability of impact
10 - 50m	2 hundred million	1 in every 5 years	Siberia, 1908: area not populated.	0.2
100m	2 hundred thousand	1 in every thousand years	China, 1490: 10,000 deaths	0.001
1-2km	2 thousand	1 in every 100,000 to 1 million years	Argentina, 3 million years ago: local extinctions and global cooling	0.00001
15km	50	1 in every 65 million years	Mexico, 65 million years ago: dinosaur extinction	0.00000002

What can we see from this table?

<i>Size</i>	<i>Number near Earth</i>	<i>Frequency of impacts</i>	<i>Last impact</i>	<i>Annual probability of impact</i>
<i>10 - 50m</i>	<i>2 hundred million</i>	<i>1 in every 5 years</i>	<i>Siberia, 1908: area not populated.</i>	<i>0.2</i>
<i>100m</i>	<i>2 hundred thousand</i>	<i>1 in every thousand years</i>	<i>China, 1490: 10,000 deaths</i>	<i>0.001</i>
<i>1-2km</i>	<i>2 thousand</i>	<i>1 in every 100,000 to 1 million years</i>	<i>Argentina, 3 million years ago: local extinctions and global cooling</i>	<i>0.00001</i>
<i>15km</i>	<i>50</i>	<i>1 in every 65 million years</i>	<i>Mexico, 65 million years ago: dinosaur extinction</i>	<i>0.00000002</i>

- Missing rows? Smooth data?
- 10-50m asteroids: 1 in 5 years – last impact 1908?
- 15km asteroids: 1 in 65 million years – ONE data point?
 - Next one due now??????
- How are these estimates made?

The Torino Scale: Impacts of particular asteroids



Events having no likely consequences.

Events meriting careful monitoring.

Events meriting concern.

Threatening events.

Certain collisions.

The Torino Scale: Impacts of particular asteroids

- 0 – either 0 probability of impact or no significant effect
- 1 – Events meriting careful monitoring, but very unlikely
- 2-4 – Events meriting concern: ~1% chance of regional devastation
- ...
- 10 – global climatic catastrophe: probability about 1 in 100,000 years

Good News!
Nasa
database lists
no objects > 1

**What
happened to
1 in 65 million
years?**

Stop looking at the web: look at something authoritative!

- Report of the (UK) Task Force on potentially hazardous Near Earth Objects (2000)
 - Note NEO not asteroid
- Who wrote it?
 - **Hey! I am acknowledged!!!!**
- But ...er... What did I do?
 - 10 min telephone conversation?
- Phew! Probability of Mass extinctions back to 1 in 10-100 million years.

How about academic journals?

Rough argument

- Probability of end of humanity due to asteroid impact is ~ 1 in 100 million
- World population about 6.75 Billion
- So expect ~67 deaths per annum
- Add in a few other asteroid catastrophes that kill 10s of millions
- Per annum risk from asteroid impact is about that of air crashes.

Chapman and Morrison NATURE (1994)

By now I am confused

- Not clear where half the estimates actually come from.
- Incomplete specifications of the events over which probabilities are given
- Data? Expert judgements? Models?
- I understand that such estimates/judgements evolve over the years – but what is the path?
- But nothing excuses plain dumb probability calculations!

So where does this leave us?

We need to consider:

- reporting standards for expert judgement studies that allows them to be audited and evaluated;
- meta-analytic methodologies for expert judgement data.

Reporting and Archiving

- Cooke's four principles, we need to discuss, augment, agree and implement them.
- We cannot change what happens across the web, but we can create well managed archives.
 - TU Delft database
- Establish peer review procedures

Future use of EJ Studies

- Informal in problem formulation phase
- A guide for 'bounds' in sensitivity analysis
- To build scenarios
- But really we need a methodology for Meta-analysis of expert judgements.

Conclusions

- Public and stakeholder involvement is changing societal risk management.
- Complex systems etc. are making expert judgement more necessary.
- We need to consider how to publish and meta-analyse expert judgement reports.
- We are nowhere near doing this

More details

Simon French (2011)

AGGREGATING EXPERT JUDGEMENT

Revista de la Real Academia de Ciencias Exactas, Físicas y Naturales. Serie A. Matemáticas
105(1), 181–206

Simon French (2011)

EXPERT JUDGEMENT, META-ANALYSIS AND PARTICIPATORY RISK ANALYSIS

Under review for *Decision Analysis*.

Thank you