Risk Perception

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Disagreement Between Experts & General Public?

Public often accepts expert evaluations, but not always

- "Public" is large, diverse

Disagreement can go either direction

- Lay people perceive greater risk
  - Nuclear power & waste
  - Hazardous-waste sites
- Lay people perceive smaller risk
  - Avian flu, hurricanes
  - Dietary supplements

Explaining Expert – Lay Disagreement

Ideology

- Natural v. synthetic
- Large, globalized v. small, localized control
  - e.g., centralized power generation v. small-scale distributed sources

Mistrust experts

- Corrupt, self-interested?
- History of inaccuracy (BSE?)

Dual rationalities

- Experts – probability or expected value of harm
- Lay people – "psychometric" attributes, probability neglect
- Cognitive (slow, laborious) v. affective (rapid, intuitive)

Psychometric Attributes

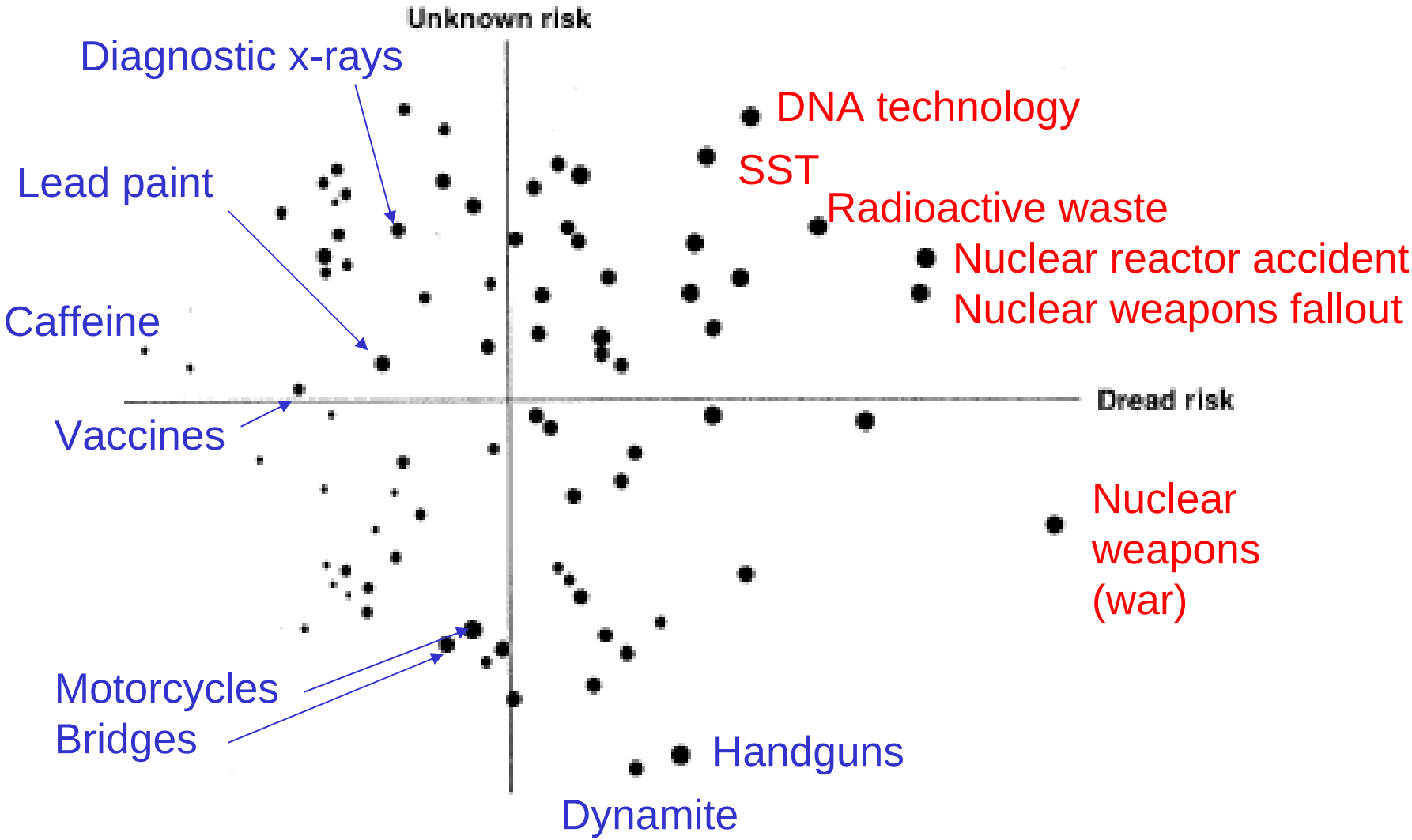
Factor analysis suggests multiple attributes may be condensed into two primary factors

Dread

- Uncontrollable, involuntary, catastrophic, inequitable distribution of benefits, affects future generations

Uncertain

- Unobservable, not understood scientifically, delayed consequences, newly recognized



Demand for regulation indicated by size of dot (Slovic 1987)

Value of Reducing Risk: Modest Effect (at most)

Hammitt & Liu 2004, Taiwan

- 100% premium for lung disease from air pollution v. liver disease from drinking water
- 30% premium for fatal cancer over similar non-cancer illness

Jones-Lee & Loomes 1995, UK

- 50% premium for small-scale underground v. road

Chilton et al. 2002, UK

- < 25% premium for rail, domestic or public fire fatalities v. road crashes

Magat, Viscusi & Huber 1996, US

- No premium for terminal lymphoma v. automobile fatality

Itaoka et al. 2006, Japan

- No premium for unlikely catastrophe (0.005/yr, 20,000 deaths) v. routine loss (100 deaths)

Psychometric Attributes: Legitimate Concerns or Cognitive Errors?

Expert models often over-simplified

- Ignore distribution of risks & benefits
- Omit non-fatal health effects
- Ignore individual control

Informal evaluations often biased

- Framing: inconsistent responses to alternative logically equivalent descriptions
- Heuristics & biases

Both groups oversimplify toxicity – "the dose makes the poison" (Paracelsus)

Framing

Flu next year forecast to cause 600 deaths

Choice: A or B?

- A. Save 400 for sure
- B. Save 600 with probability 2/3, save none with probability 1/3

Choice: C or D?

- C. 200 die for sure
- D. None die with probability 2/3, 600 die with probability 1/3

Heuristics & Biases
(Tversky and Kahneman 1974)

In estimating probabilities & other quantities, people often rely on cognitive short-cuts (heuristics)

- Representativeness
- Availability
- Anchoring & adjustment

Helpful & efficient, but produce systematic biases

Representativeness

Probability assessed by degree to which instance expresses characteristics of the class

Biases:

- Insensitivity to prior probability
- Insensitivity to sample size

Insensitivity to Prior Probability

Dick is a 30 year old man. He is married with no children. A man of high ability and high motivation, he promises to be quite successful in his field. He is well liked by his colleagues.

Is it more likely that Dick is

- A lawyer?
- An engineer?

Insensitivity to Prior Probability

Same estimates when drawn from:

- 70 lawyers and 30 engineers
- 30 lawyers and 70 engineers

Without (noninformative) description, people (correctly) report probability = prior probability

Availability

Probability assessed by ease of producing examples

Biases:

- Retrievability
  - Salience of recently viewed traffic crash
- Efficacy of search set
  - More English words with "r" as 1st or 3rd letter?
- Imaginability
  - Imaginability of ways project could go bad need not be correlated with probability

Anchoring & Adjustment

Estimate % of African states in UN

Sensitive to explicitly random starting value

- 25 (random seed = 10)
- 45 (random seed = 65)

Overconfidence

Generally, people are overconfident (give confidence intervals are too narrow)

"Surprise Index"

- Fraction of realizations outside the 0.01 and 0.99 fractiles
- If perfectly calibrated, 2%
- Often between 20 and 45%

Ambiguity Aversion

Humans dislike ambiguous (uncertain) probabilities

- Risk of bad outcome
- Risk of bad probability

Should we take greater precaution when probabilities are uncertain?

- Conservative assumptions
- Worst-case analysis

Perils of Prudence
(Nichols & Zeckhauser 1986)

Conservative assumptions, worst-case analysis, and ambiguity aversion can increase risk

Technology	Deaths	Probability	Expected deaths
Ambiguous	1	0.99	
	1,000	0.01	11
Sure	101	1.0	101

Using upper-bound risk estimates, Sure would be preferred to Ambiguous

Perils of Prudence

If decision is repeated for 10 pairs of technologies (and risks are independent)

Technology	Deaths	Probability
Ambiguous	10	0.904
	< 1,010	0.996
Sure	1,010	1.0

Policy of choosing Sure (with smaller upper-bound risk) is almost certain to kill more people

Quantifying Probability

Probability of harm from nanotechnology is "subjective"

- Quantitative measure of degree of belief
- Individuals can hold different probabilities for same event

All probabilities are subjective

- "Objective randomness" is really chaos (e.g., coin toss, roulette wheel)
  - Deterministic process
  - Sensitively dependent on initial conditions
  - Insufficient information about initial conditions

Expert – Lay Disagreement: Explanation or Rationalization? (Margolis 1996)

Ideology

- Need not imply disagreement about risk

Mistrust experts

- Tautological?
- When are experts trusted or mistrusted?

Dual rationalities

- Attribute ratings may be result of disagreement with experts, not cause
- Perceived benefits inversely associated with perceived risks (Sunstein)

Perceived Risk Depends on Salience of Benefits and Danger (Margolis 1996)

	Benefit salient?	
Danger salient?	Yes	No
Yes	Balance	Better safe than sorry
No	Waste not, want not	Indifferent

Conclusions

Experts and public sometimes perceive risk differently

- What explains when & direction of disagreement?

Attributes beyond probability & severity

- Distinguish legitimate concerns from cognitive error
- Rationale rather than predictor?

Salience & distribution of benefits & harms are critical