

Why people don't get risk analyses: The fault is in ourselves

W. Troy Tucker and Scott Ferson
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Troy@ramas.com; Scott@ramas.com

Why is risk communication hard?

Experts often say the public is irrational

But maybe what experts have been telling
people is incomprehensible or irrelevant

**We need to understand what people are
evolved to comprehend**

CMU risk communication (e.g. Morgan et al. 2002)

Practical and effective

Iterated step-by-step program

1. Produce an expert model of the risk
2. Survey and describe extant mental models
3. Produce communication materials that alter extant models to conform to the expert model
4. **Rinse and repeat steps 2 and 3**

An emerging view of mind (evolutionary psychology)

Mind consists of many domain-specific calculators
(Marr 1982; Barkow et al. 1992; Pinker 1997, 2002)

Information *format* triggers a specific calculator
(e.g. Cosmides & Tooby 1996; Gigerenzer 1991)

Emotions provide prior probabilities to calculations
Multiple calculators produce contrasting solutions
Emotions also choose among and combine solutions
(e.g. Glimcher & Rustichini 2004 and references therein)

List of mental calculators (after Pinker 2002)

- Language (grammar and memorized dictionary)
- Practical physics (pre-Newtonian)
- Intuitive biology (animate differs from inanimate)
- Intuitive engineering (tools designed for a purpose)
- **Intuitive psychology (deception, mistrust)**
- Spatial sense (dead reckoner and mental maps)
- **Number sense (1, 2, 3, many)**
- **Probability sense (frequentist Bayes)**
- **Practical economics (reciprocity, trust, equity, fairness)**
- Mental database and logic (assertions linked with logical and causal operators)

People are *good* risk calculators

When provided with natural frequencies

76-92% correct Bayesian reasoning
(Cosmides & Tooby 1996; Gigerenzer 1991)

When faced with short-term variability

Foraging, maximizing rewards or minimizing costs
(Hawkes et al. 1982; Bechara et al. 1997)

When engaged with multiple actors

Cheater detection, ultimatum game
(e.g. Cosmides 1989; Guth 1995)

People are *bad* risk calculators

... or often *seem* bad when

1. Presented with percentages, large numbers, or single-event probabilities
2. Risk is seen to be imposed
3. Experts tell them the risk
4. Presented with incertitude (versus variability)
5. Encountering probabilistic independence
6. Prior probabilities are formed from memory or imagination

1. Percentages, large numbers, or single-event probabilities

No calculator evolved to take these as inputs
Natural frequencies are the preferred input

Makes reference class clear

(Cosmides and Tooby 1996; Gigerenzer 2002)

Mental calculators are frequentist

Probability of single event is uninterpretable

(Cosmides and Tooby 1996)

Ensure information is correctly formatted

Incorrect formatting

People fail when provided with percentages and single-event probabilities

If a test to detect a disease whose prevalence is 1/1000 has a false positive rate of 5%, what is the chance that a person found to have a positive result actually has the disease, assuming that you know nothing about the person's symptoms or signs? ___%

Casscells et al. 1978 replicated in Cosmides and Tooby 1996

12-18% correct Bayesian reasoning

Correct formatting

People succeed when provided with natural frequencies

If a test to detect a disease whose prevalence is 1/1000 has a false positive rate of 50/1000, what is the chance that a person found to have a positive result actually has the disease, assuming that you know nothing about the person's symptoms or signs? ___ out of ___.

Casscells et al. 1978 replicated in Cosmides and Tooby 1996

76-92% correct Bayesian reasoning

2. When risk is imposed

... People say it's riskier

Even when the risk is smaller than voluntary risks

Multiple mental risk calculators perceive risk

Some perceive risk of disease, death, economic cost

Some perceive risk of social contract violation

(e.g. Cosmides 1989, Guth 1995)

Bilateral anterior insula: disgust (e.g. Sanfey et al. 2003)

Make clear who benefits and that compensation is proportional

3. When experts tell the risk

Communication: A signal or display meant to produce behavior in the recipient that is beneficial to the sender (Krebs & Davies 1981)

The messenger is more important than the message

Trust in motive: what's in it for the expert?

Trust in ability: are experts wrong?

Equity: will someone benefit without paying the cost?

Make clear who benefits; make motives clear

4. When risk is uncertain

... People concentrate on the worst case
But ignore how unlikely the bad outcome is
Precautionary principle

Uncertainty triggers a specific calculator(s)

ventromedial prefrontal cortex

(Glimcher & Rustichini 2004; O'Doherty et al. 2001; c.f. Loewenstein et al. 2003)

Evolution favors caution in the face of ambiguity

Death is an absorbing state

Explicit analysis of uncertainty required

The role of emotion in decisions

Allows quick and accurate response

Anticipatory skin conductance (Bechara et al. 1997)

Links calculation to decision

Brain injury: know the answer but make wrong choice

Enhances memories that form prior probabilities

(Glimcher & Rustichini 2004)

Manifests innate responses

Summary

- Multiple mental risk calculators
- Information format is a trigger
Mistakes can be made
- Multiple calculators perceive risk simultaneously
People can be of two (or more) minds about a risk
- Emotions give priors, weights, and induce choice
- Overall risk perception may be a combination

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Unknown risk and dread risk

Slovic's 1987 graph shows two axes of risk

Unknown risk

Observable, awareness, time to effect, new

Uncertainty regarding the frequency of an event

Dread risk

Controllable, catastrophic, fatal, long-term, voluntary

Uncertainty regarding the adversity of an event

Separation of frequency and adversity

How bad could it be? How likely will it occur?