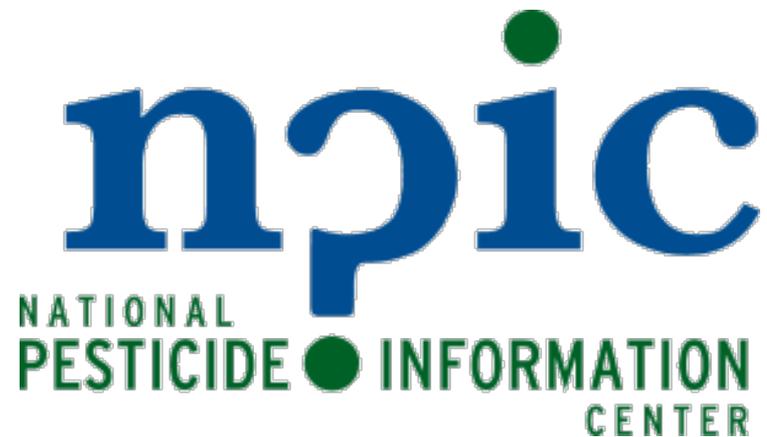




Risk Assessment & Risk Perception

Kaci Buhl, MS





1.800.858.7378

npic@ace.orst.edu

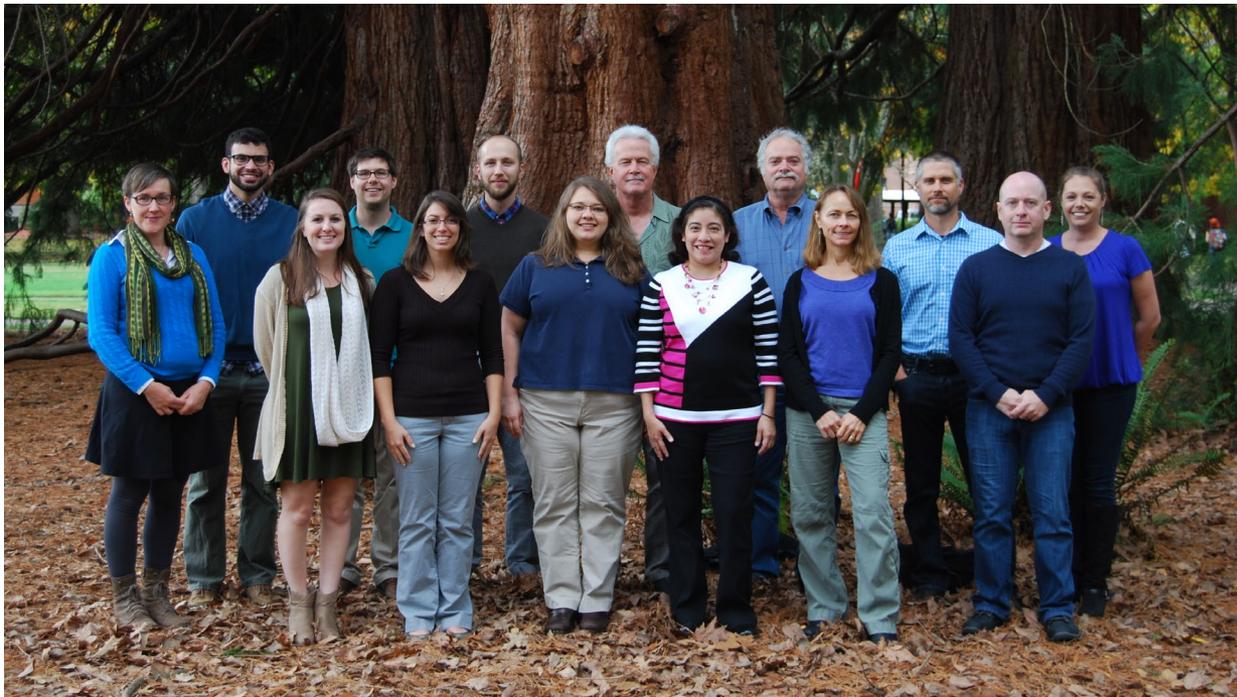
Environmental & Molecular Toxicology



Call the National Pesticide Information Center

1.800.858.7378

- A science-based information service for pesticides
- 8:00 – 12:00 PT
- Funded through a cooperative agreement with EPA
- ~ 12,000 inquiries per year





Outline

- Basics of Toxicology
- Chemical Risk Assessment
- The science of risk perception
- A framework for risk communication

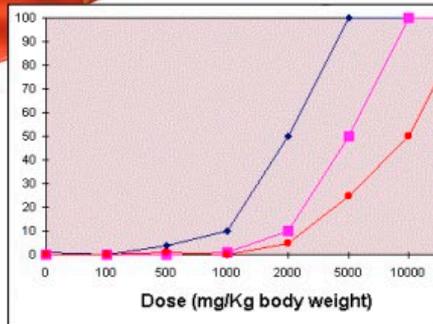
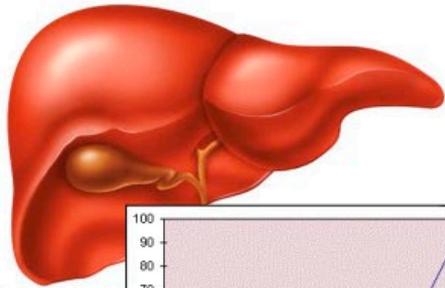
BASICS OF TOXICOLOGY

Dose

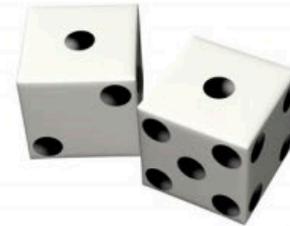
Dose

.... And Dose

Risk Assessment



magnitude of effect



&

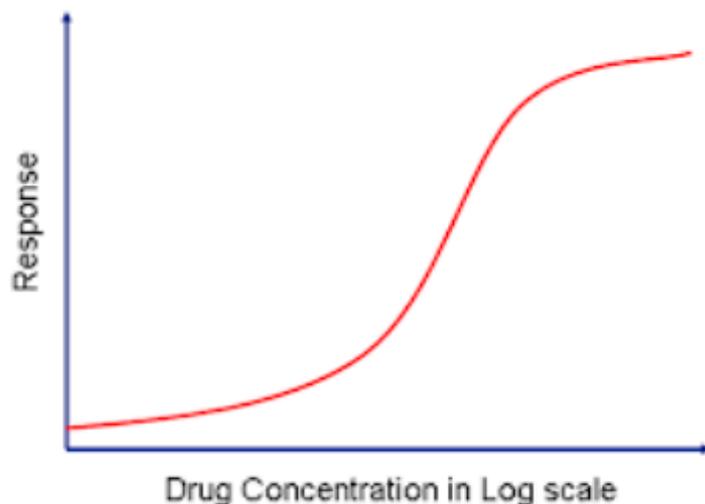


probability of exposure

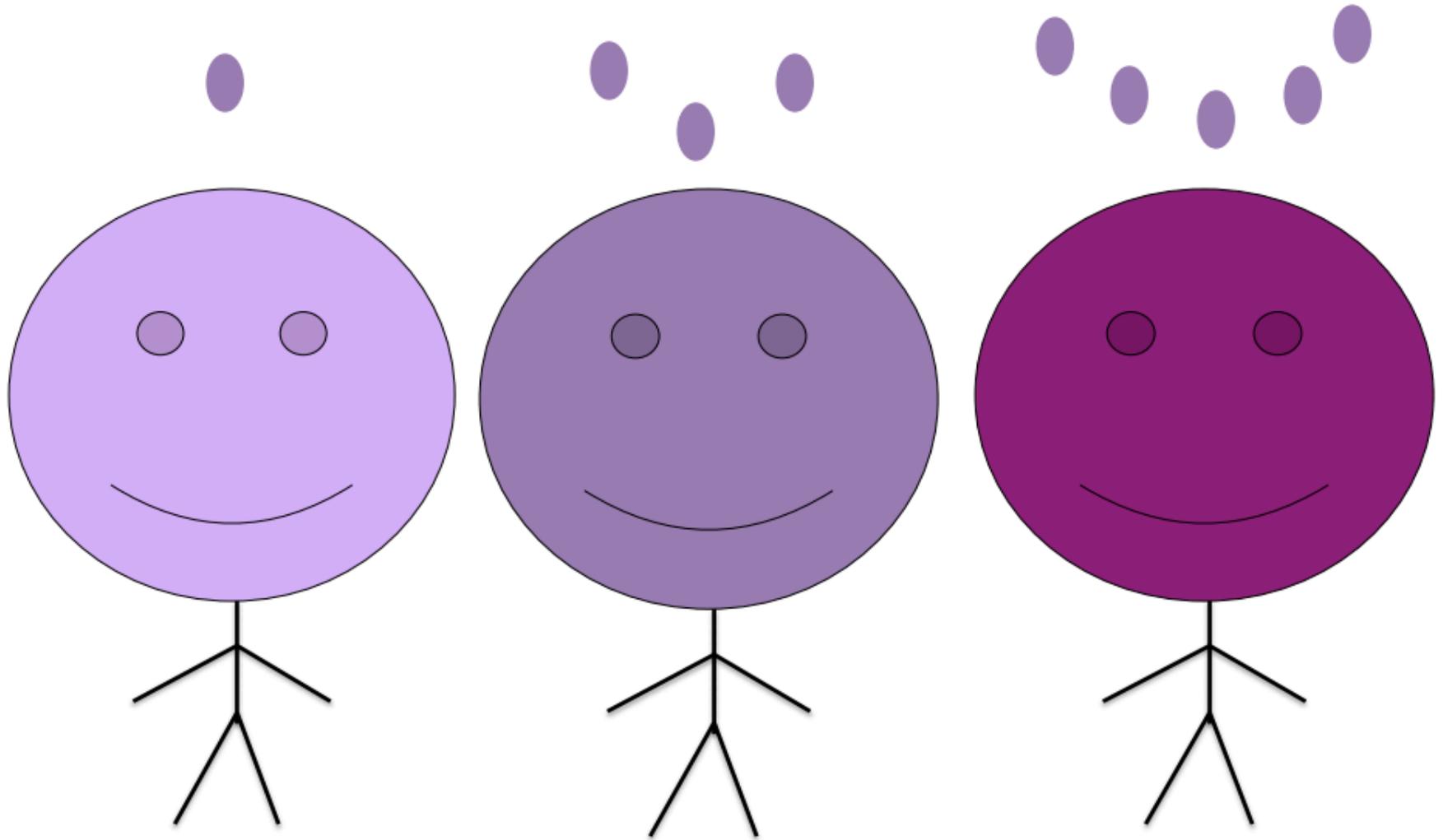
Dose-Response Relationship

A key concept in Toxicology is the **quantitative relationship** between the **concentration** of a chemical in the body and the **magnitude** of the biological effect. The dose is typically expressed as: concentration of a chemical (mg) / body weight of the organism (kg).

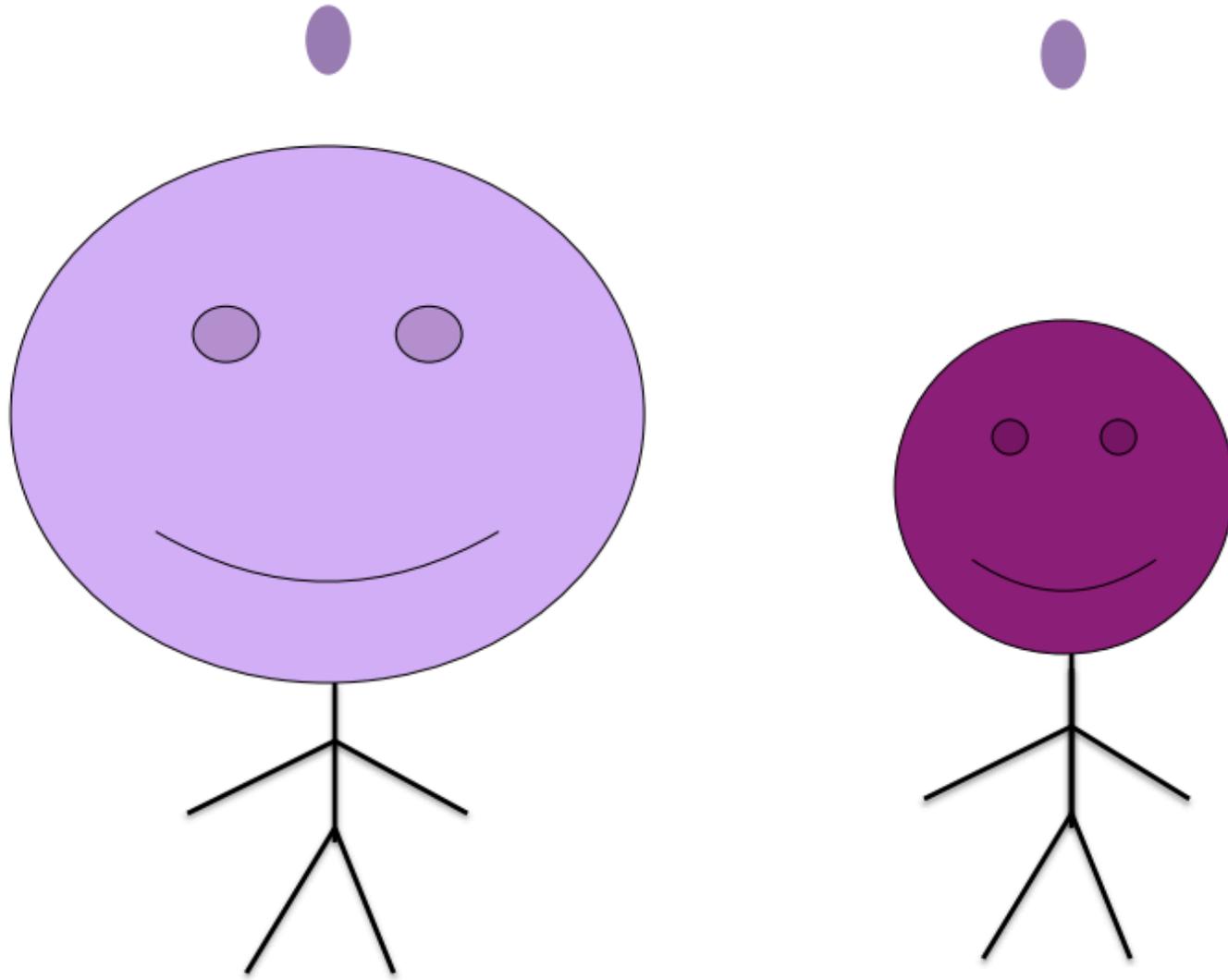
In any given population, there will be a range of sensitivity to a chemical. However, it is useful to know the average sensitivity of a population to a certain dose.



Effect of Amount on Dose



Effect of Size on Dose

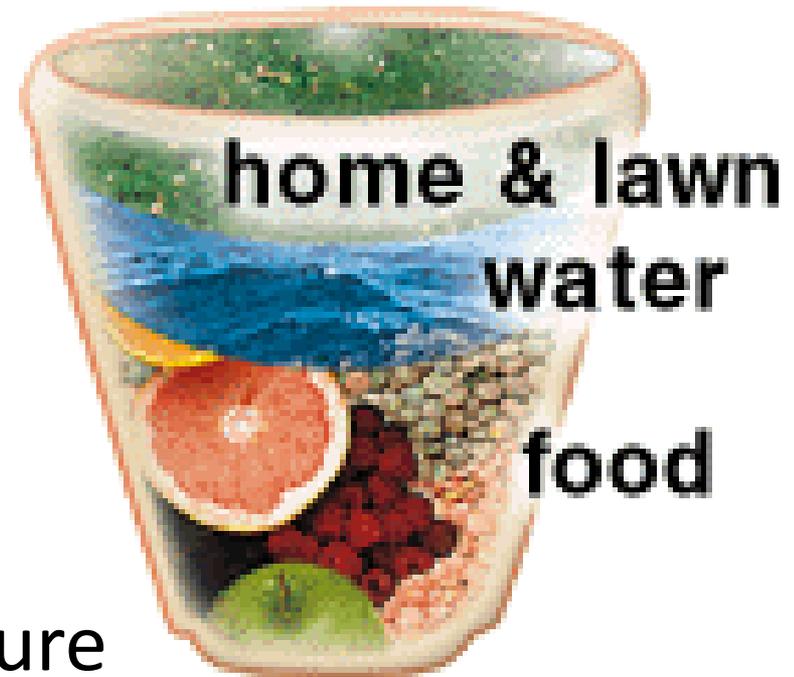


Exposure Assessment

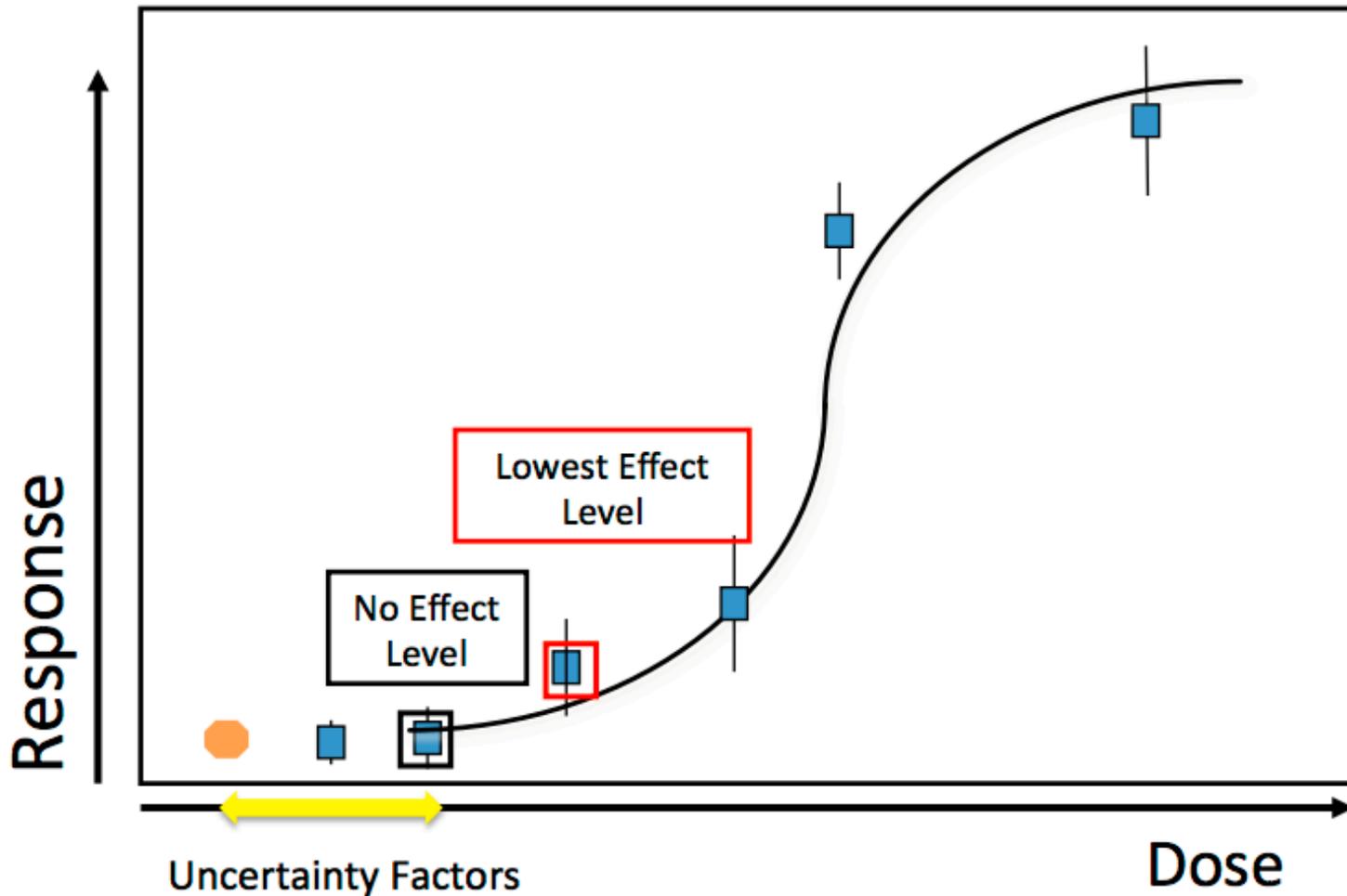
- Drinking water
- Occupational exposure
- Home use
- Residue on food
 - How much do we eat?



★ Estimated expected exposure



Dose-Response Curves and Regulation



Where Do We Get Our Data

Traditionally, society has used animals to predict toxicity in humans. Animals are exposed to high doses over a shorter lifespan compared to ours.

A well-designed dose-response study conforms to standards and includes:

- adequate controls
- multiple dose groups
- both genders
- controlled diets
- good animal husbandry practices
- validated statistical interpretation



Determining an Acceptable Dose

A reference dose (RfD) or acceptable daily intake (ADI) is the daily exposure to people (including sensitive subgroups) that is likely to be without an **appreciable** risk of adverse effects *during a lifetime*. Notice it doesn't say "zero risk."

Typically, RFD = NOAEL / Uncertainty Factors

For pesticides, a scalable Margin of Exposure Approach (MOE) is often used. This is part of how food tolerances are set.

**MOE = NOAEL / Estimated or Measured Human
Exposure**

Dose with no effects/Expected exposure

Risk is considered low if:

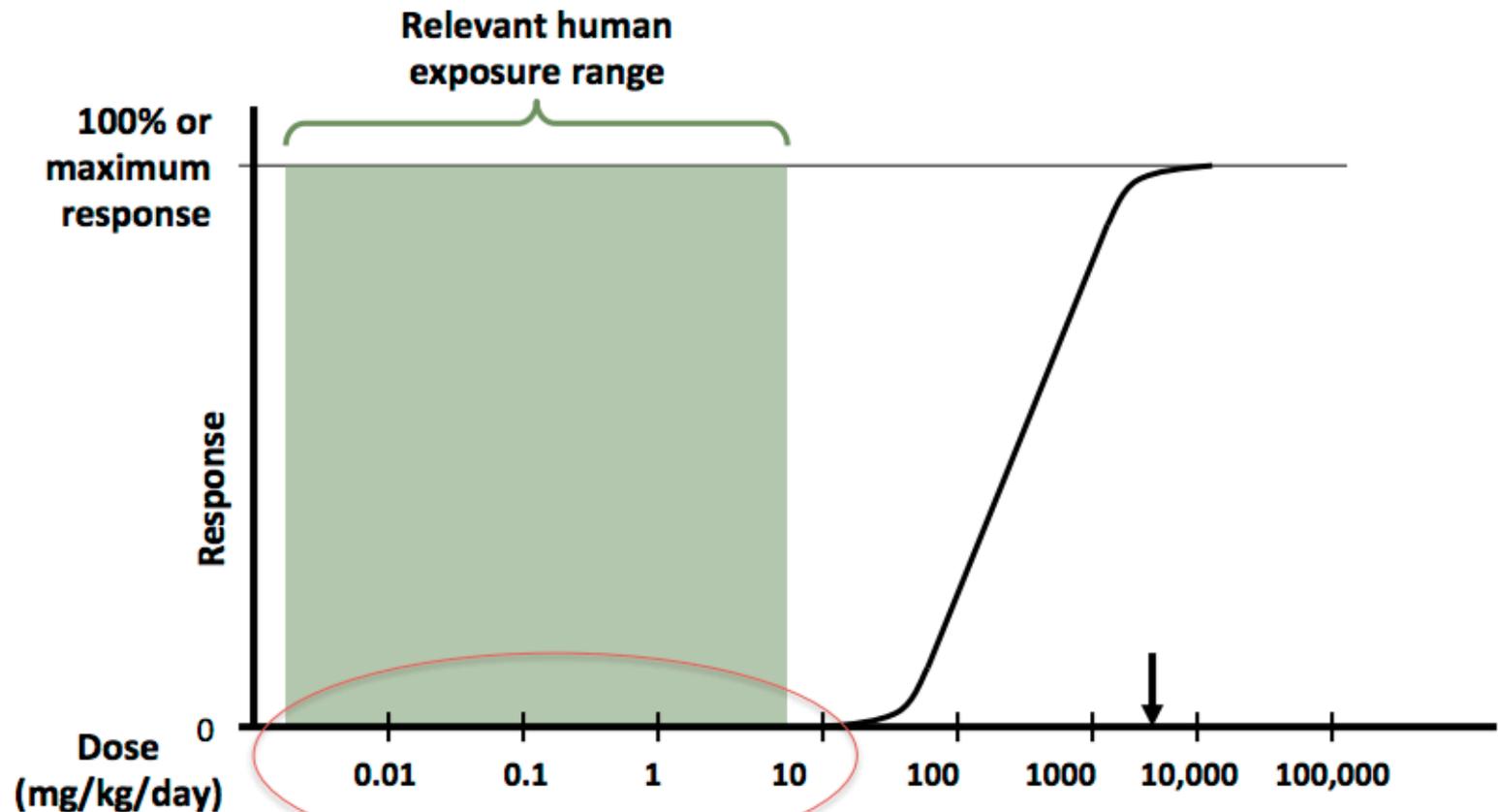
The dose with no effects is 100 times larger than the expected exposure level (dose).

If there's no NOAEL, and we use the LOAEL instead,

Risk is considered low if:

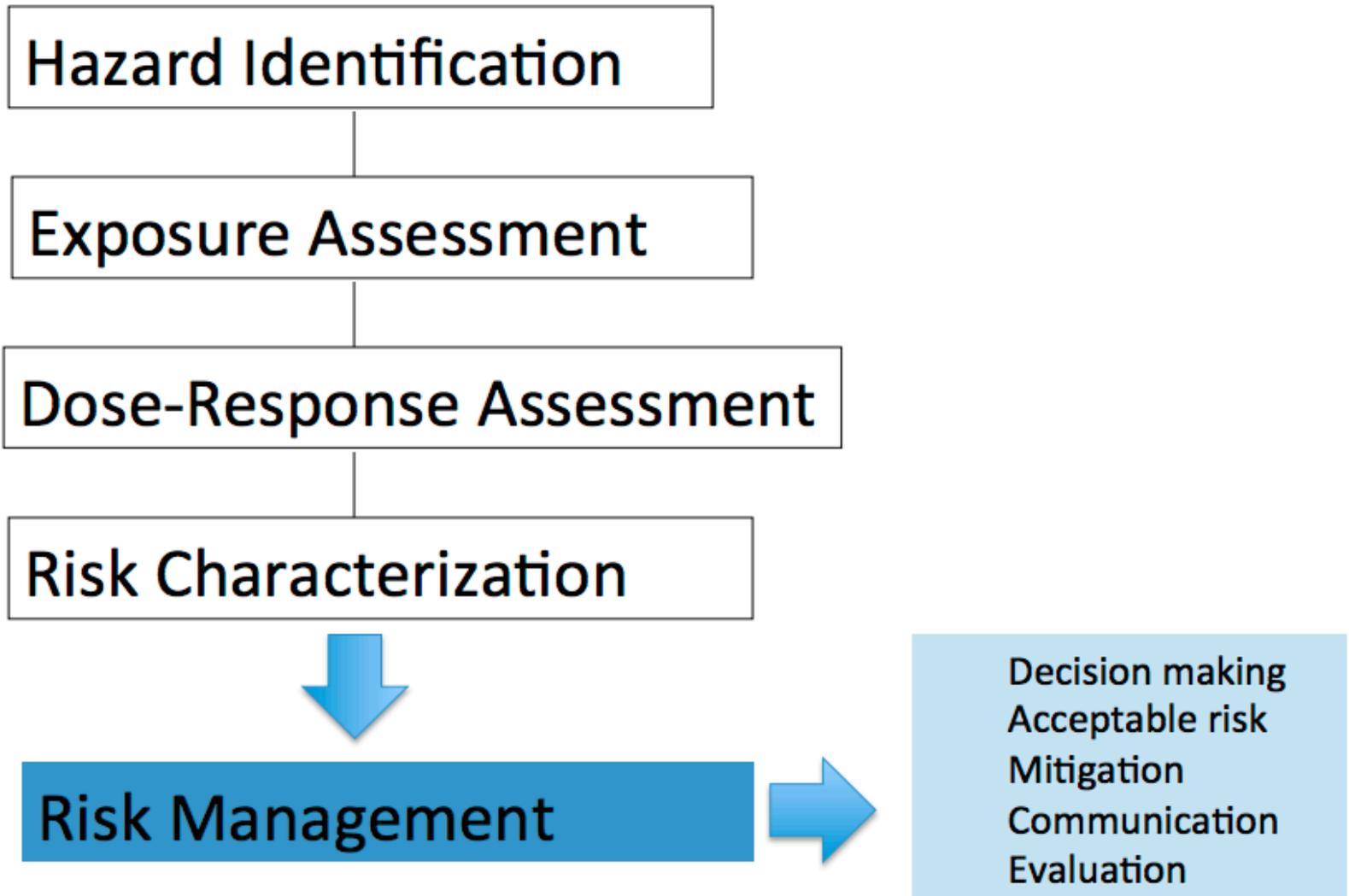
The lowest dose that causes effects is 1000 times larger than the expected exposure level (dose).

Low Dose Exposure



What does this mean for chronic exposures over a lifetime and cancer?

Risk Assessment Paradigm



Examples of Risk Management for Pesticides

The Label Instructions

Enforcement

Post-market surveillance & 6(a)2

Tolerances

Worker Protection Standards

Restricted Use

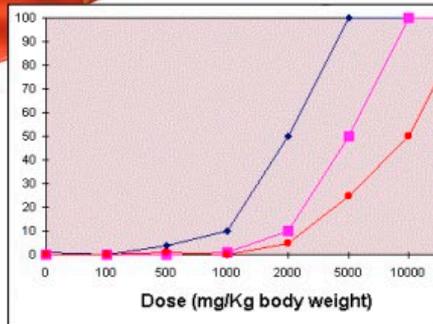
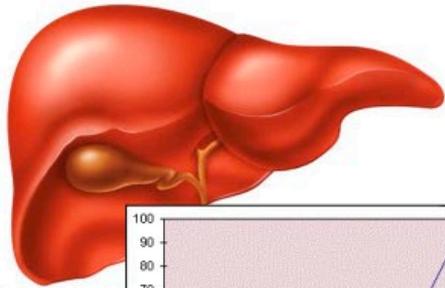
Reregistration of chemicals

Pre-harvest Intervals

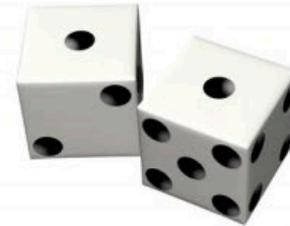




Risk Assessment



magnitude of effect



probability of exposure

&



the salt WHAT'S ON YOUR PLATE

FOOD FOR THOUGHT



Americans Don't Trust Scientists' Take On Food Issues

December 2, 2016 · 5:02 PM ET



DAN CHARLES



THE SCIENCE OF RISK PERCEPTION

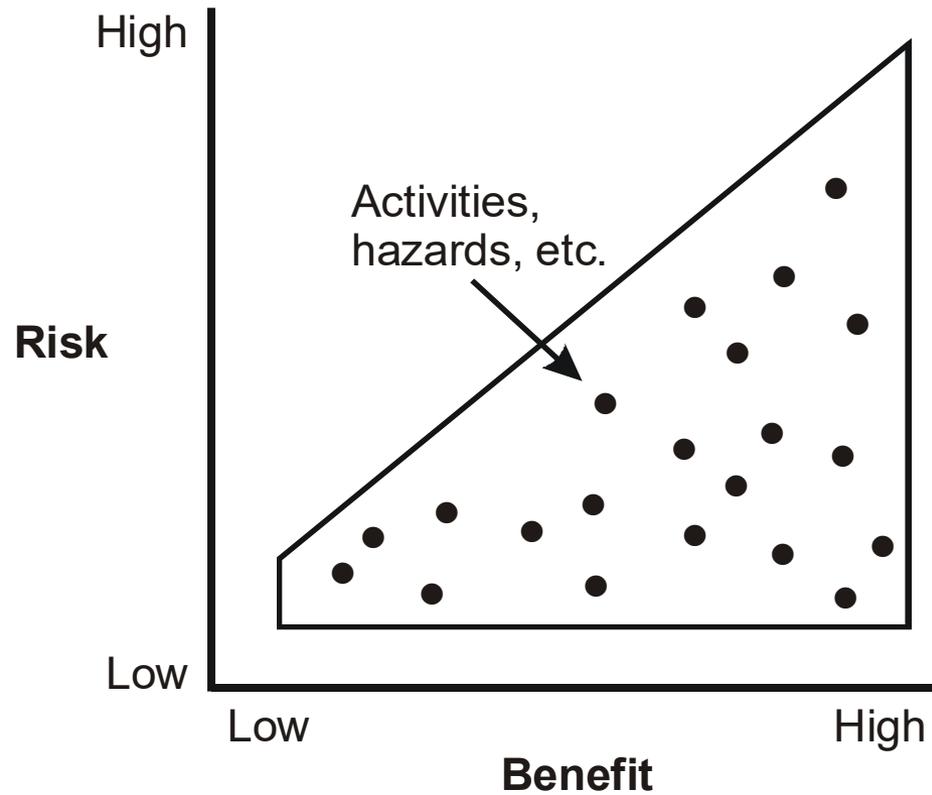


Every hazard is unique
Every person is unique

Acknowledgement: Dr. Paul Slovic, University of Oregon

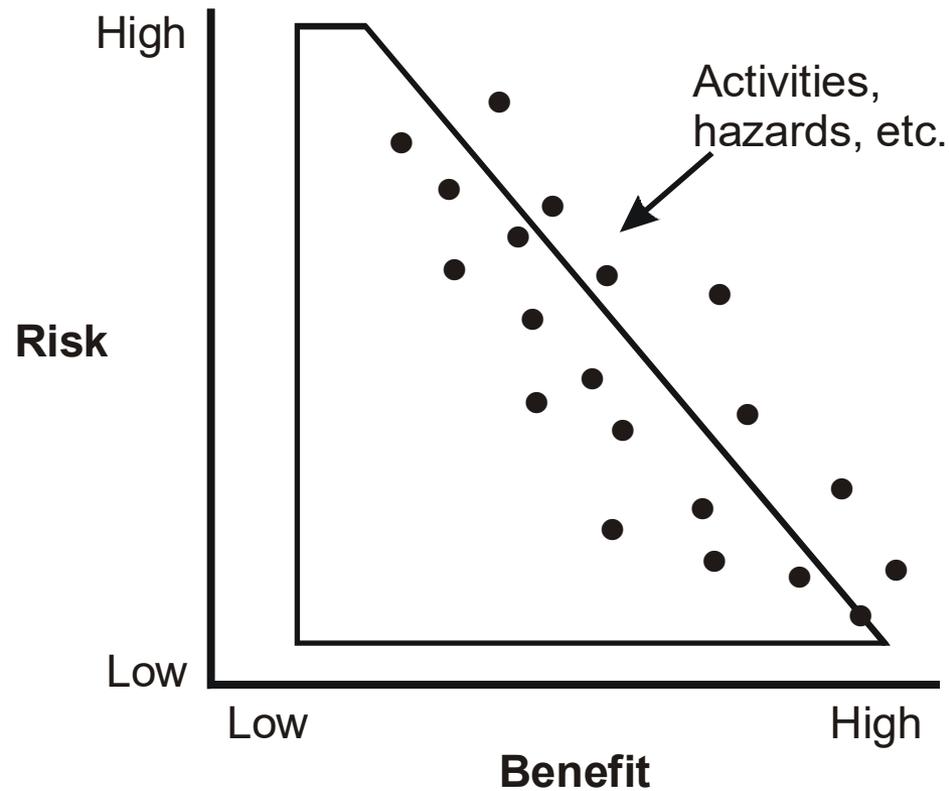
Risk Perception

- Most risk perception is determined by *fast* intuitive feelings.
- The **risk(s)** cannot be separated from the **benefit(s)** in the mind
- Understanding risk perception is critical for effective communication.



In the world, risk and benefit are **positively** correlated.

In people's minds, they are **negatively** correlated.



According to social science research, the relationship between risk and benefit in people's minds is negatively correlated.

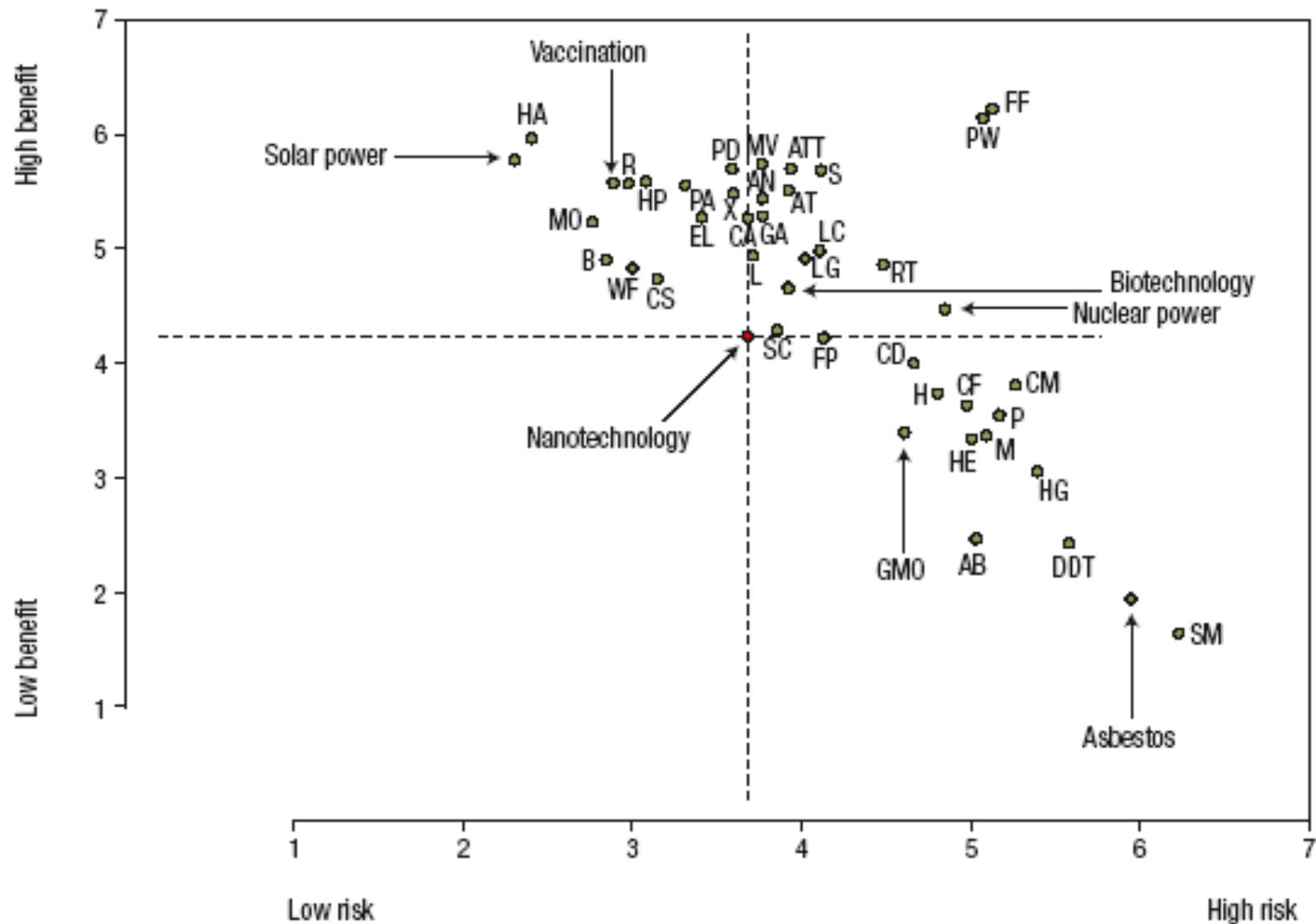
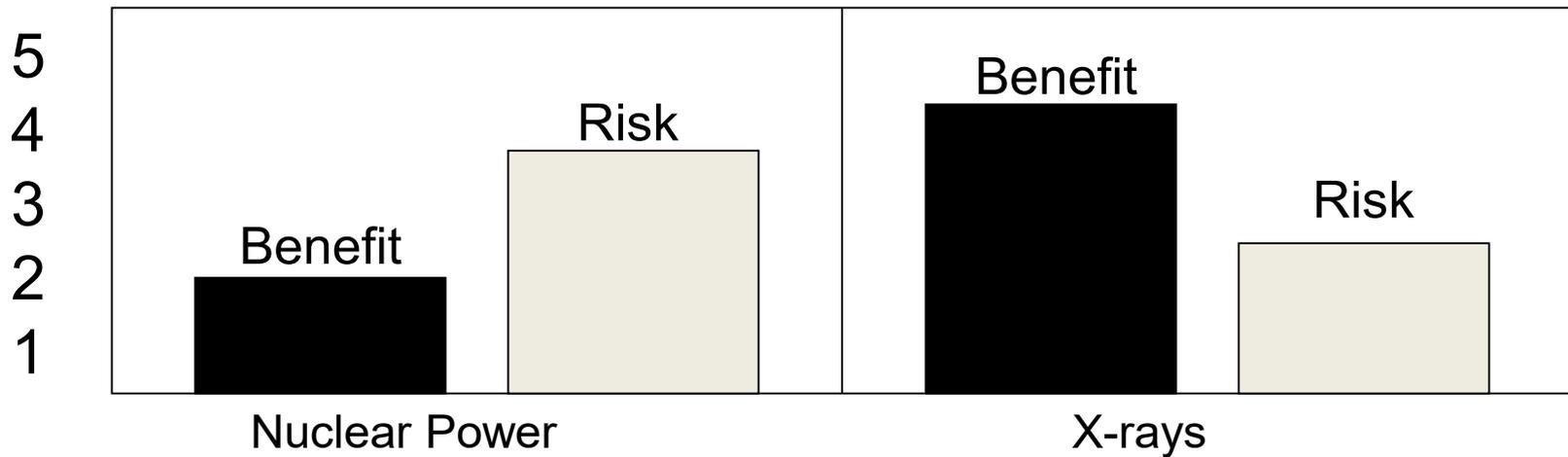


Figure 1 Perceived risks and benefits of nanotechnology and 43 other technologies, based on 503 responses to a national telephone survey. Source: Currall et al. 2006

Radiation



Chemicals

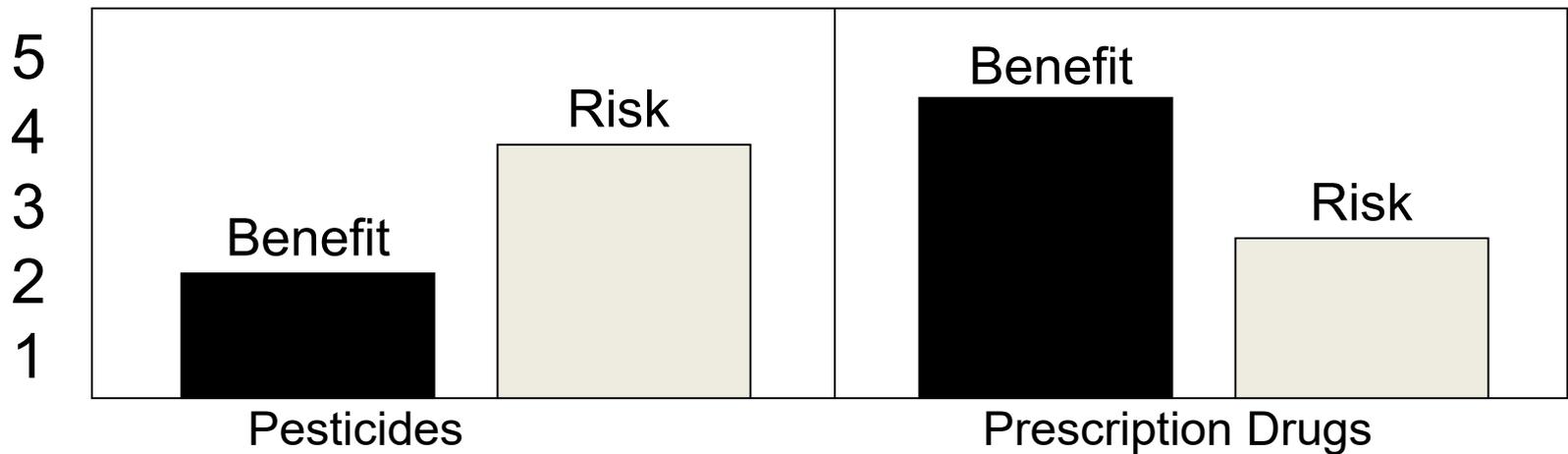


Figure 3. Mean perceived risk and perceived benefit for medical and nonmedical sources of exposure to radiation and chemicals. Each item was rated on a scale of perceived risk ranging from 1 (very low risk) to 7 (very high risk) and a scale of perceived benefit ranging from 1 (very low benefit) to 7 (very high benefit). Data are from a national survey in Canada by Slovic et al., 1991.

Risks are less likely to be acceptable if the benefits are hidden from view, or if they are not fairly distributed among those who bear the risks.

Risk denial increases with perceived control

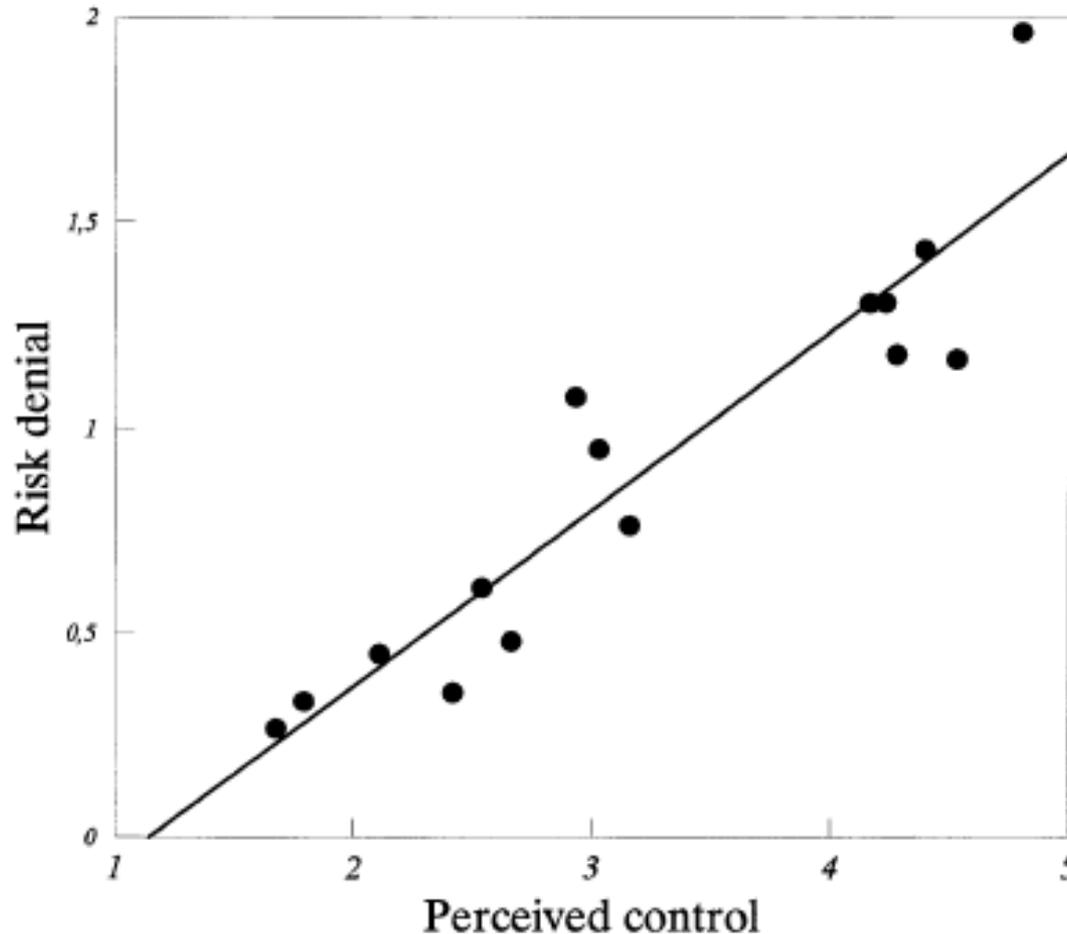
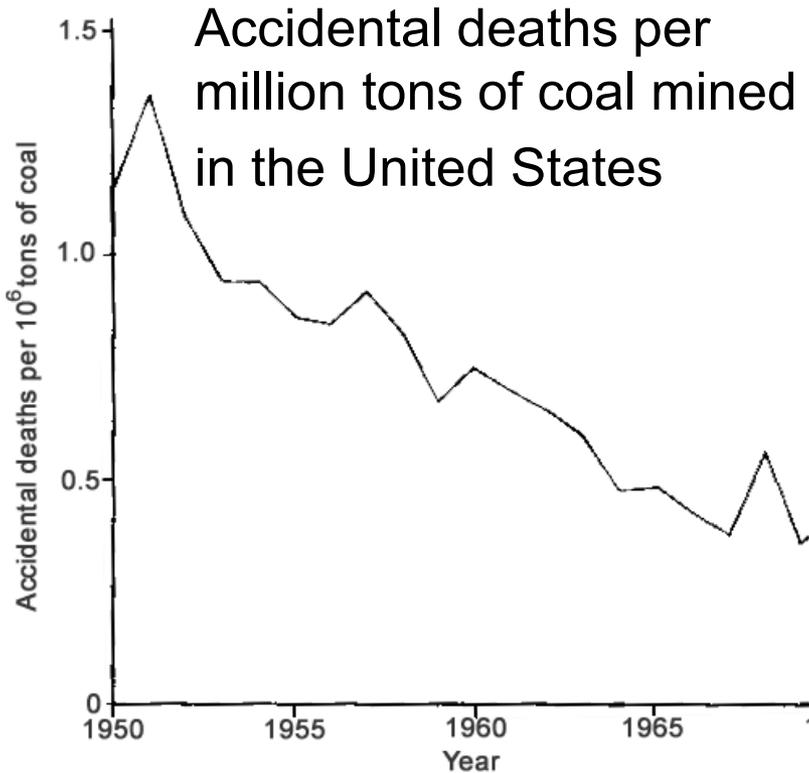


Fig. 2. Risk denial (general minus personal risk) plotted against perceived control over risks. Each point corresponds to one hazard; mean ratings are plotted.

How is risk defined? Who decides?

Is coal mining getting safer?



Defining risk is an act of power

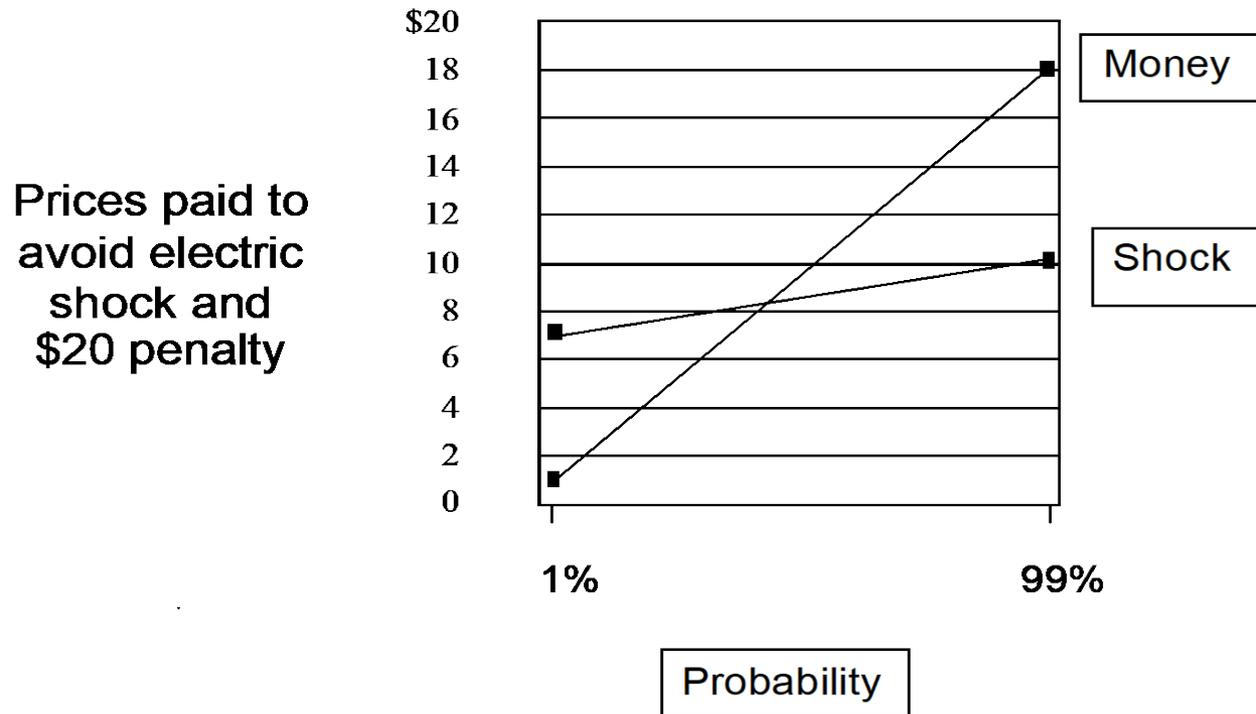
Counting fatalities gives equal weight to:

- Young and old
- Painful and painless deaths
- Voluntary and involuntary exposure(s)
- Fair (beneficial) and unfair (no benefit)

Gut feelings

- Feelings about ***outcomes*** and feelings about ***probabilities*** are often confused.
- When strong emotions are involved, there is 'probability neglect.'

Strong Emotion Overcomes Probability



Payment to avoid a chance of electric shock is not much affected by probability

Source: Rottenstreich & Hsee:
Money, Kisses, and Electric Shock: On the Affective Psychology of Risk.
Psychological Science, 2001

Terrorism and Probability Neglect

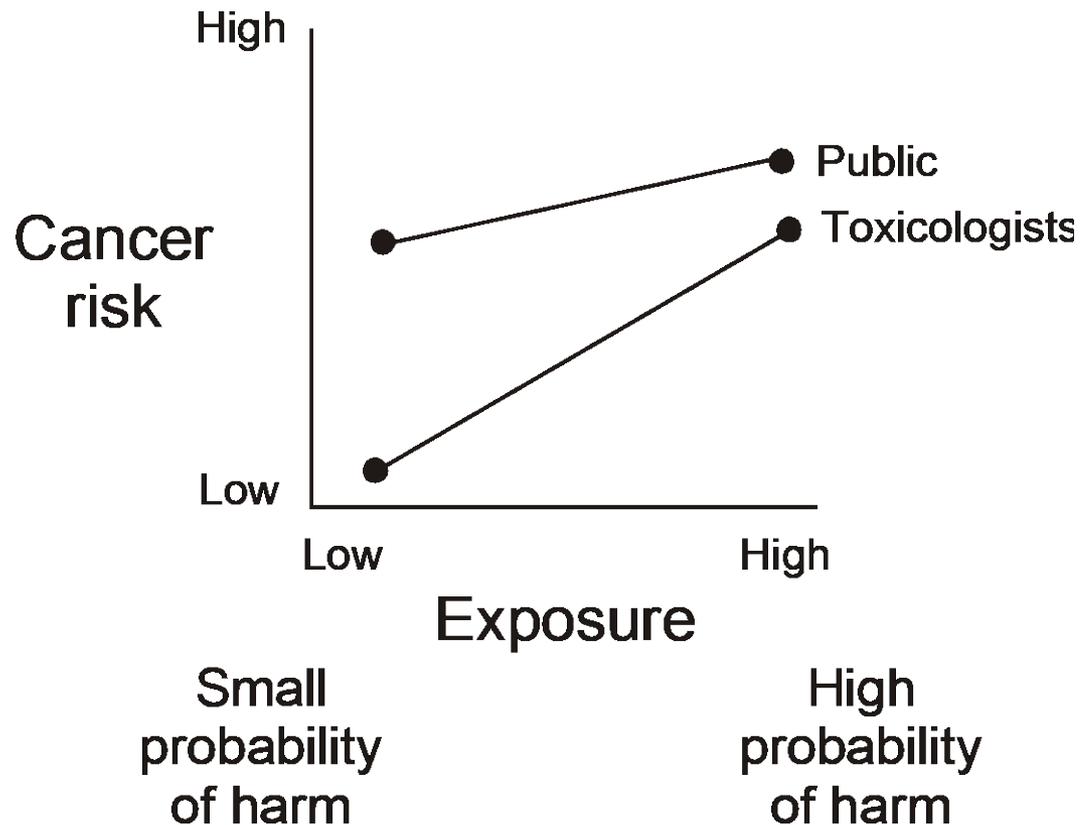
Cass R. Sunstein

The Journal of Risk and Uncertainty, 26(2/3); 2003

- People are prone to . . . *probability neglect* when their emotions are intensely engaged.
- When probability neglect is at work, people's attention is focused on the bad outcome itself, and they are inattentive to the fact that it is unlikely to occur.

Many people lack dose-response sensitivity for exposure to chemicals that can produce dreaded effects, such as cancer.

If large exposures are bad, small exposures are also bad.



People with different worldviews were asked about their attitudes towards nanotechnology, before and after being given information about nanotechnology.

Some questions that measure worldviews (agree?)

The government should stop telling people how to live their lives (Individualism)

The government should do more to advance society's goals, even if that limits the freedom of individuals (Communitarian)

Our society would be better off if the distribution of wealth was more equal (Egalitarianism)

We should let the experts make all the risk decisions for society (Hierarchism)

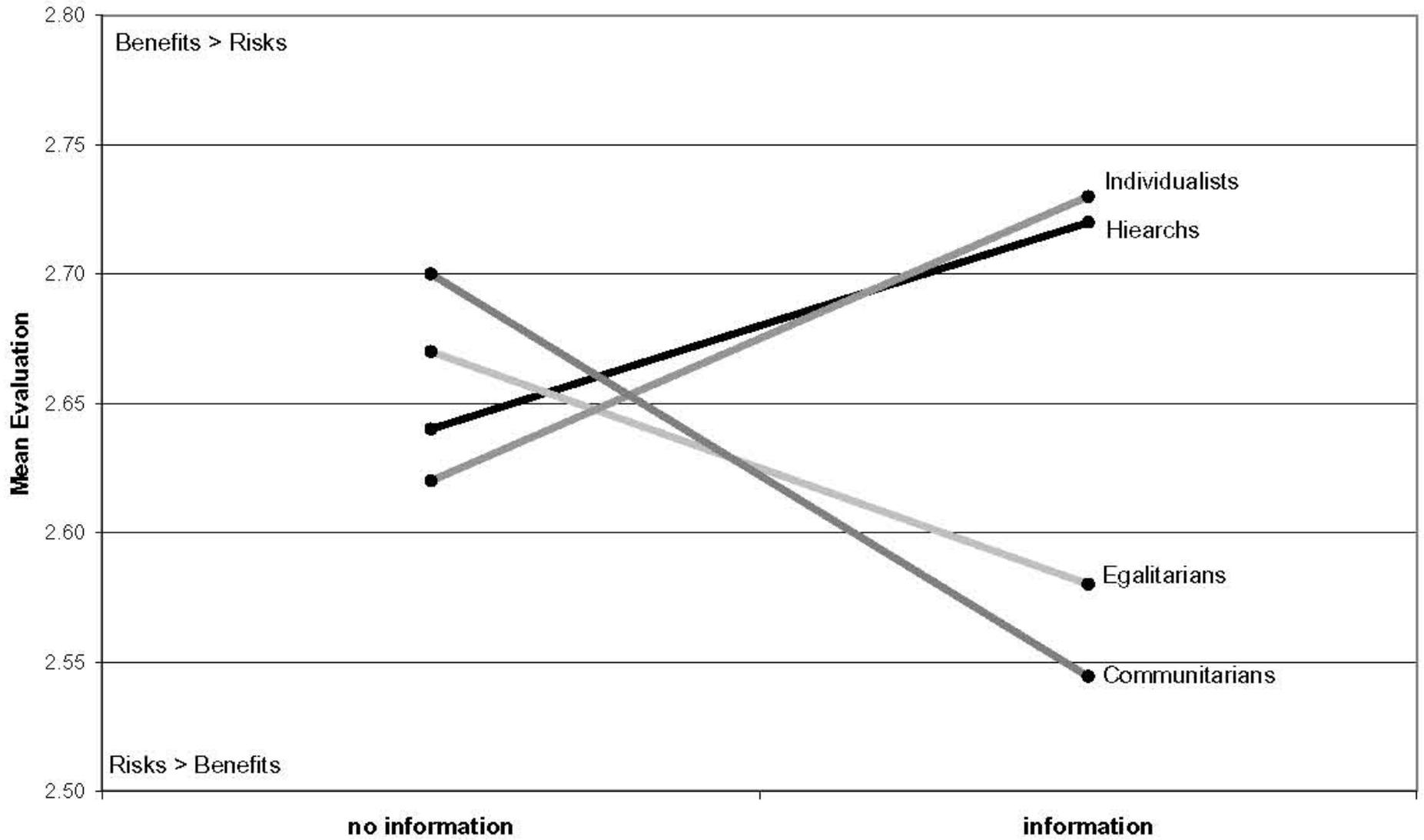
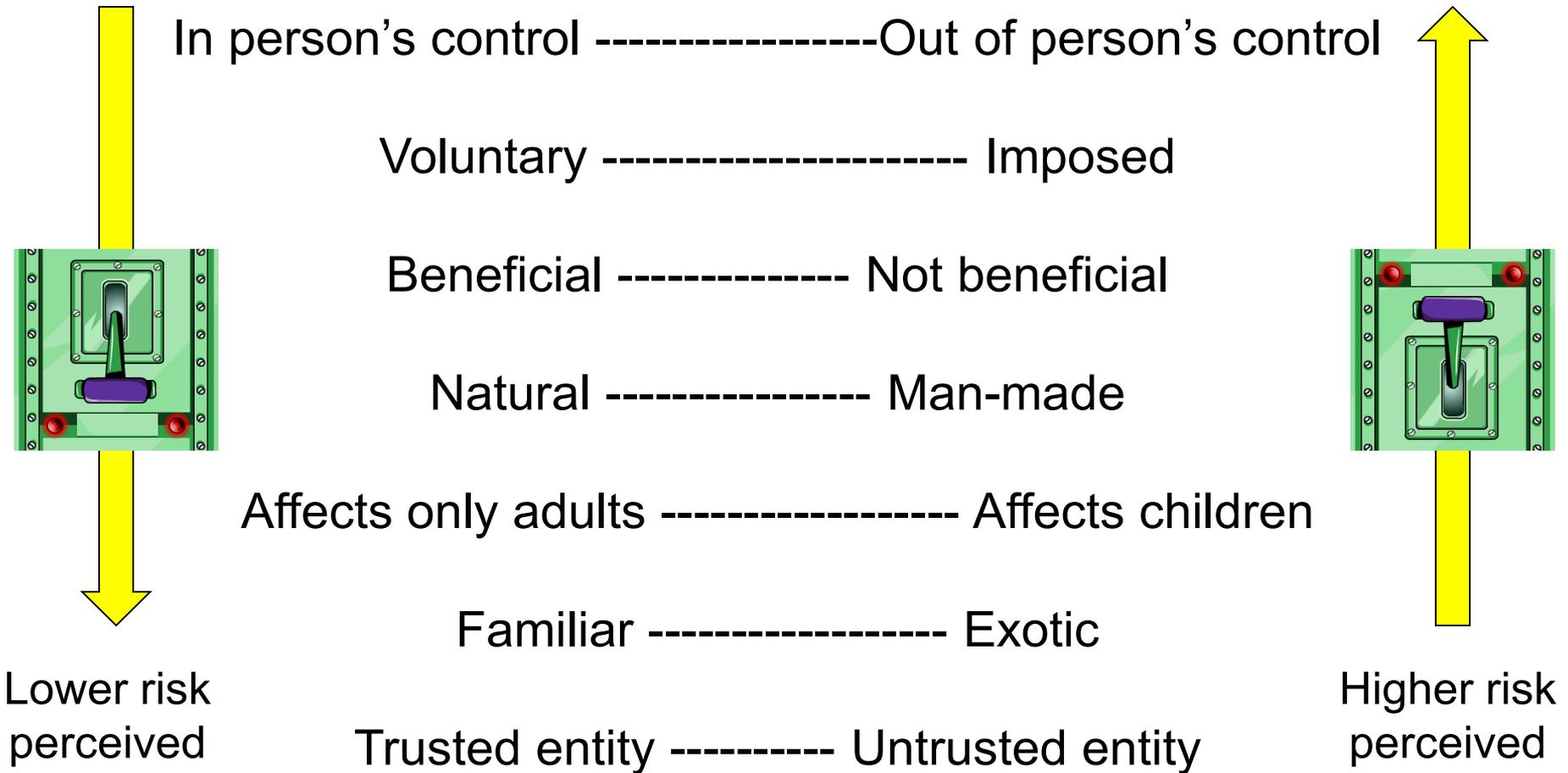
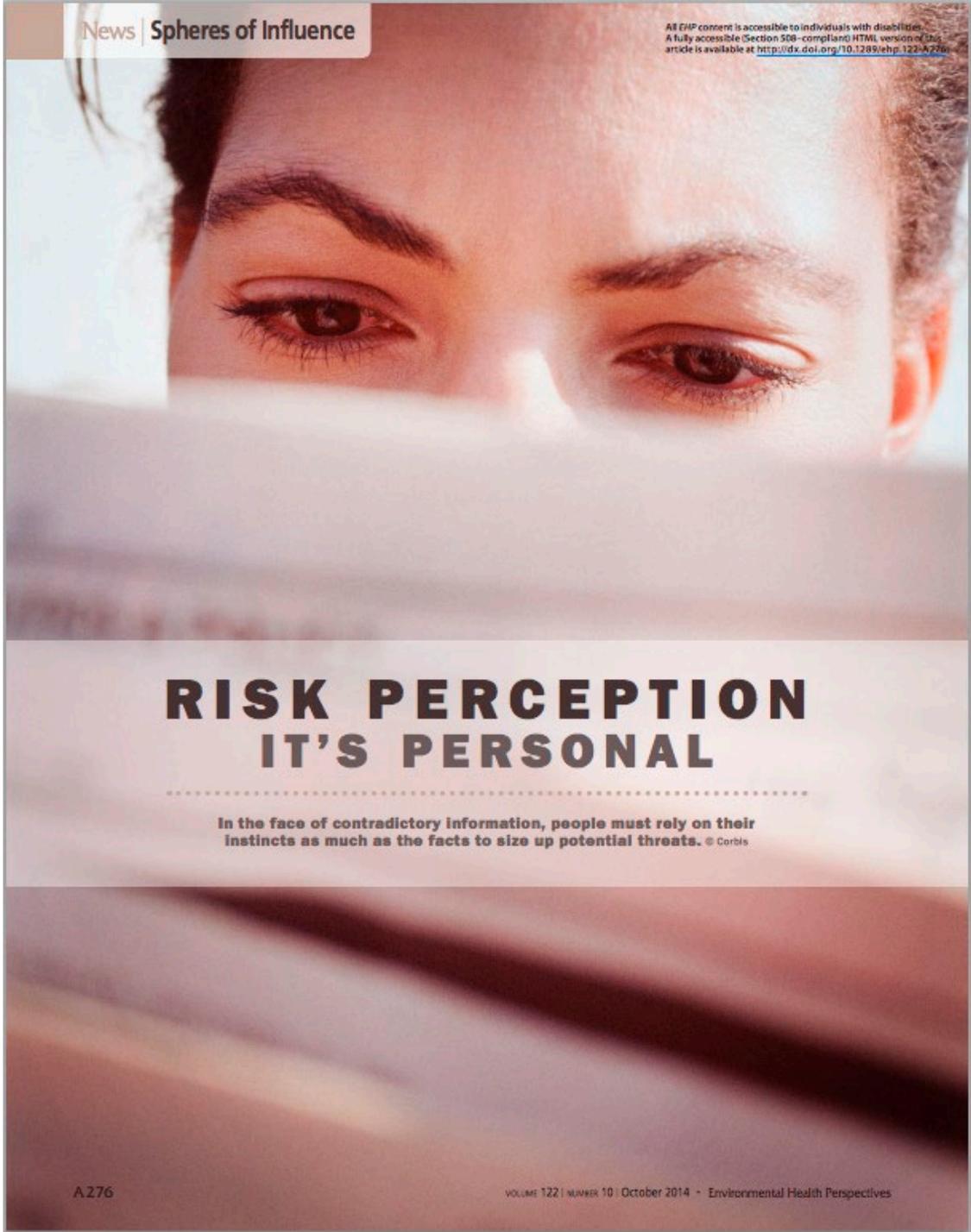


Figure 4. Impact of Information Across Condition by Dimension of Cultural Worldview

Personal 'outrage factors'





RISK PERCEPTION IT'S PERSONAL

.....
**In the face of contradictory information, people must rely on their
instincts as much as the facts to size up potential threats.** © Corbis

The word “safe” is unsafe.

Safety

Yes or No

No precautions necessary

Safe is safe for everyone

Easy to explain

Risk

More risky-----Less risky

Precautions reduce risk

Risk is higher for certain people

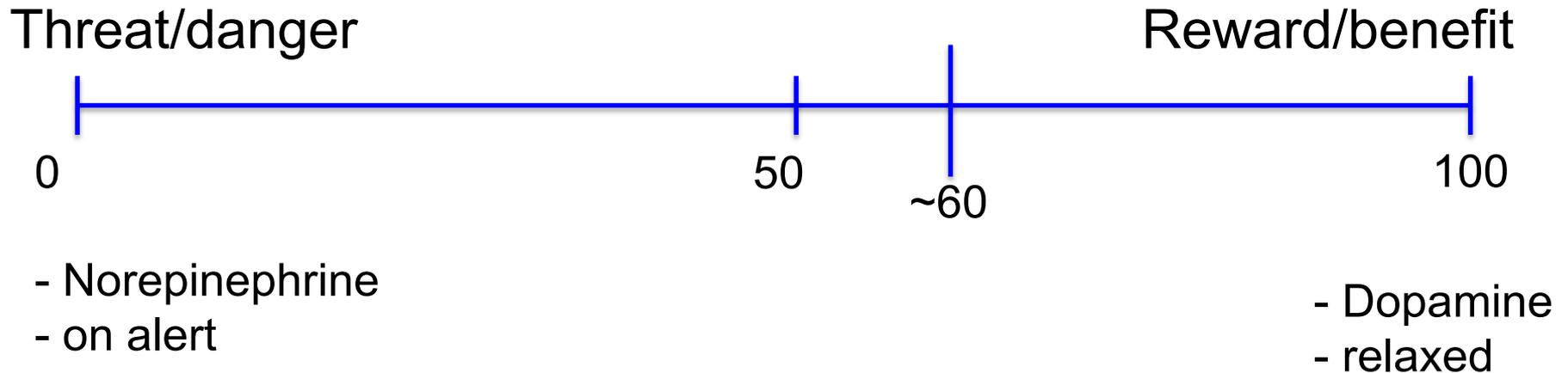
Harder to explain



The risk equation as scaffolding



Finding the Sweet Spot

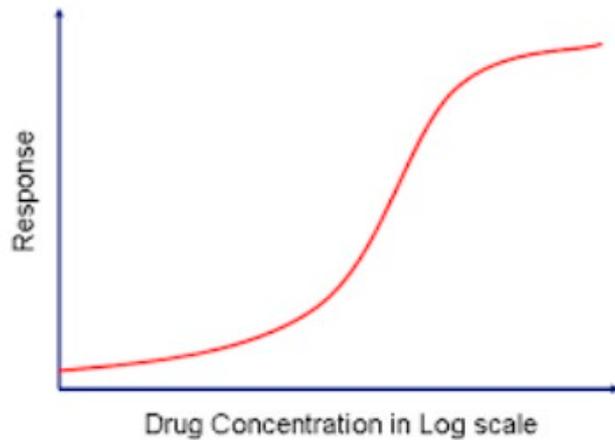


If the focus is too much on 'threat', learning shuts down.



Summary

- Chemical Risk Assessment
- The science of risk perception



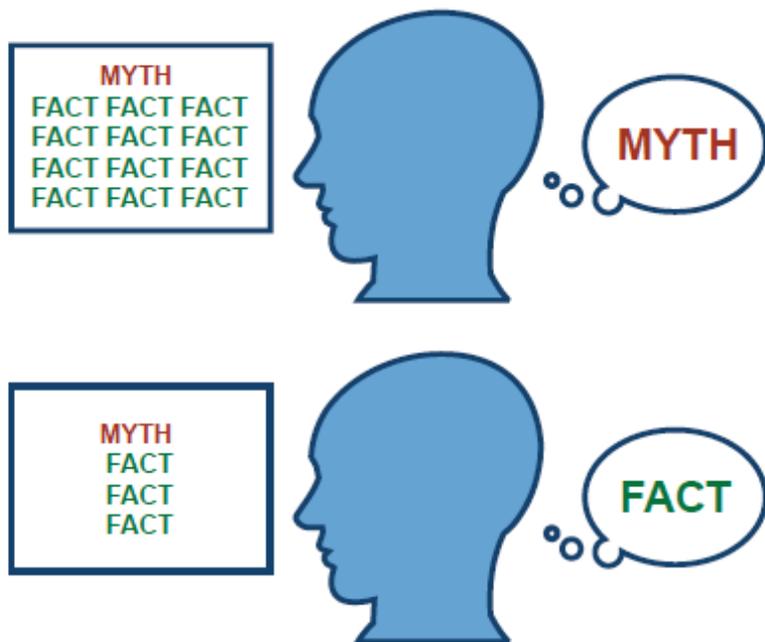
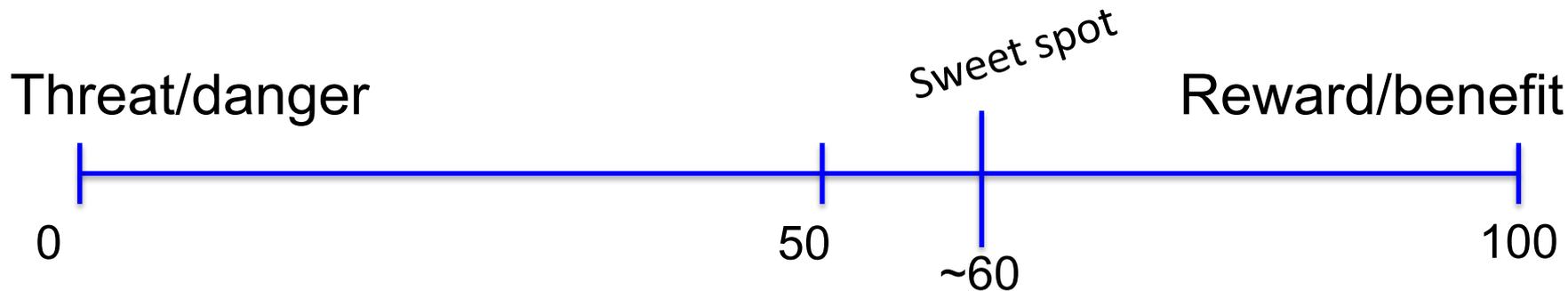
In summary, **some suggestions:**

- Chemical risk assessment measures the probability of harm by comparing dose levels.
- Personal risk ~~assessment~~ perception varies with world-view, strength of emotion, and perceived benefit.
- Probability of harm doesn't matter if emotions are strong.
- Address emotions first. Then people may consider *probability* in their personal risk ~~assessment~~ perception.

In summary, some suggestions:

- Benefit(s) often inform risk perception more than the probability of harm.
- Defining risk is an act of power.
- 'Safe' is not a safe word.

- Don't be silent about benefits when discussing risk.
- Don't define risk for people. They may feel dominated.
- Discuss risk, and ways to reduce it. Empower people.



- Describe the desirable behavior, stay positive.
- Keep it short. Too many facts can overwhelm.

Risk Assessment & Risk Perception

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