

# The Psychology of Risk

Paul Slovic

August 10, 2009

## Some Questions Briefly Addressed:

1. How do people think about risk?
2. What factors determine the perception of risk and the acceptance of risk?
3. How do we make decisions in situations of risk?

# Overview

1. Judgment under Uncertainty: Intuitive Statistics

2. Studies of Perceived Risk

- experts' and laypersons' perceptions
- the social amplification of risk
- intuitive toxicology
- cultural cognition, worldviews, and risk perception
- numeracy and risk perception

3. Risk and Trust

# Overview, continued

## 4. Risk as Analysis vs. Risk as Feeling

- the importance of affect
- experiential vs. analytic thinking

## 5. The Affect Heuristic

- probability neglect
- insensitivity to large numbers

## 6. Hunches and Risk Perception

# Risk Perception

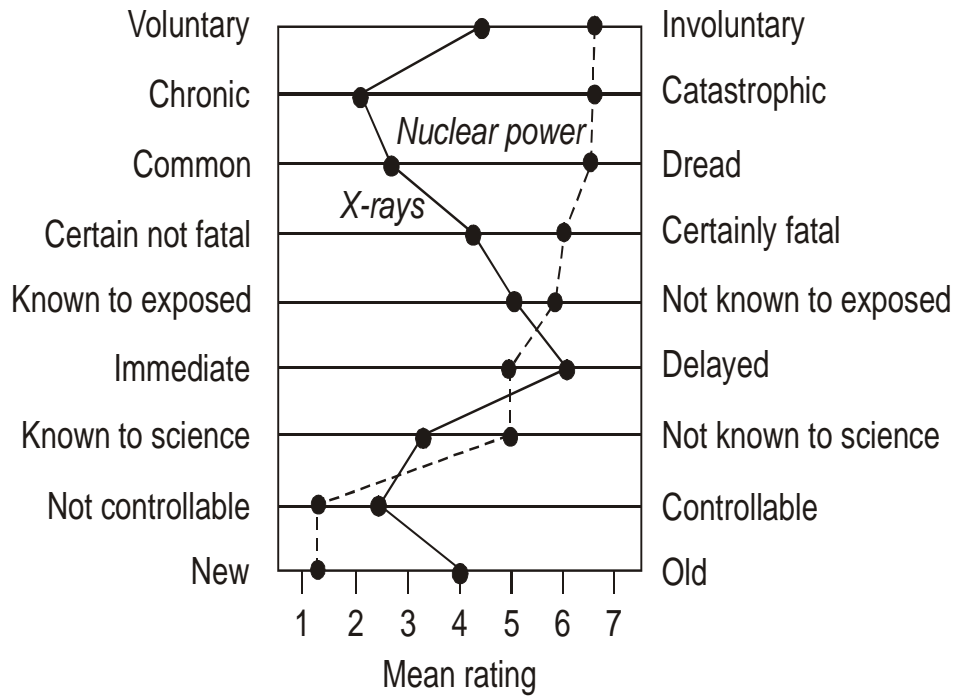
# Lessons from Risk Perception Research

2. Every hazard is uniquely understood and evaluated in terms of its characteristic qualities.

# Risk is Multidimensional

## Qualitative Risk Concerns

- Voluntary – Involuntary
- Chronic – Catastrophic
- Common – Dread
- Certainly not fatal – Certainly fatal
- Known to exposed – Not known to exposed
- Immediate – Delayed
- Known to science – Not known to science
- Not Controllable – Controllable
- New – Old
- Equitable – Not equitable





## Acceptance of Risk Tends to be Reduced if:

- The hazard is new or unfamiliar
- exposure to the hazard is involuntary
- the risk is not under one's control
- the risk evokes feelings of dread
- the outcomes are catastrophic
- the benefits of an activity are not highly visible or not fairly or equitably distributed among those who bear the risks.

## Acceptance of Risk Tends to be Reduced if:

- the risk is posed by human failure as opposed to natural causes
- the potential harms are genetic and/or delayed in time
- the risk is perceived as not well known to science or to those who might be harmed

# Lessons from Risk Perception Research

## 3. Perceptions of Risk have Impacts

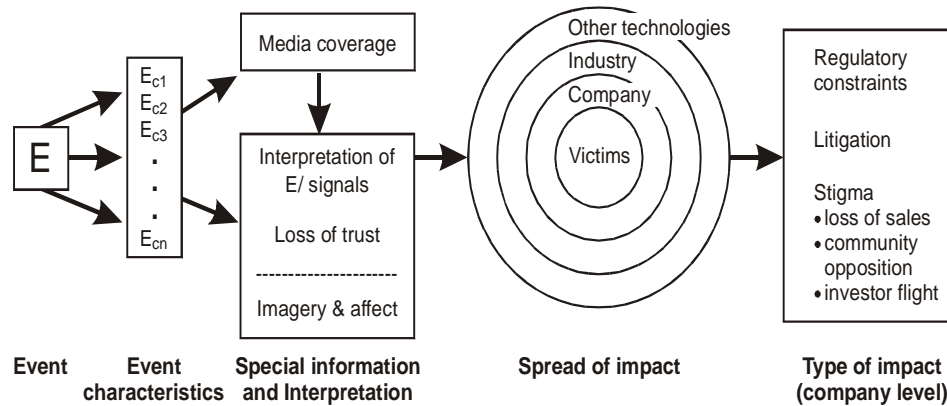
- the social amplification of risk

# The Social Amplification of Risk

Individual risk perceptions and cognitions, interaction with social and institutional forces, can trigger massive social and economic impacts due to

- response to events (even “small” incidents)
- stigma effects

# The Social Amplification of Risk



A preliminary model of social amplification of risk and stigma impacts. Development of the model will require knowledge of how the characteristics ( $E_c$ ) associated with a hazard event interact to determine the media coverage and the interpretation or message drawn from that event. The nature of the media coverage and the interpretation is presumed to determine the type and magnitude of ripple effects.

Source: Kasperson et al. (1988).

# Accidents Are Signals

1. The perceived seriousness of a mishap, the media coverage it gets, and the long-range costs to the responsible company, industry, or agency are determined by the mishap's **signal value**
2. Signal value reflects perception that the event provides new information about the likelihood of similar or more destructive future mishaps
3. High signal events: Bhopal, Chernobyl, Challenger  
“What truly grips us in these accounts [of disaster] is not so much the numbers as the spectre of suddenly vanishing competence, of men utterly routed by technology, of fail-safe systems failing . . . And the spectre haunts us because it seems to carry allegorical import, like the whispery omen of a hovering future.”

*The New Yorker*, February 18, 1985

## 4. Lessons from risk perception research

People's ideologies and worldviews strongly influence their perception and acceptance of risk.

# Worldviews

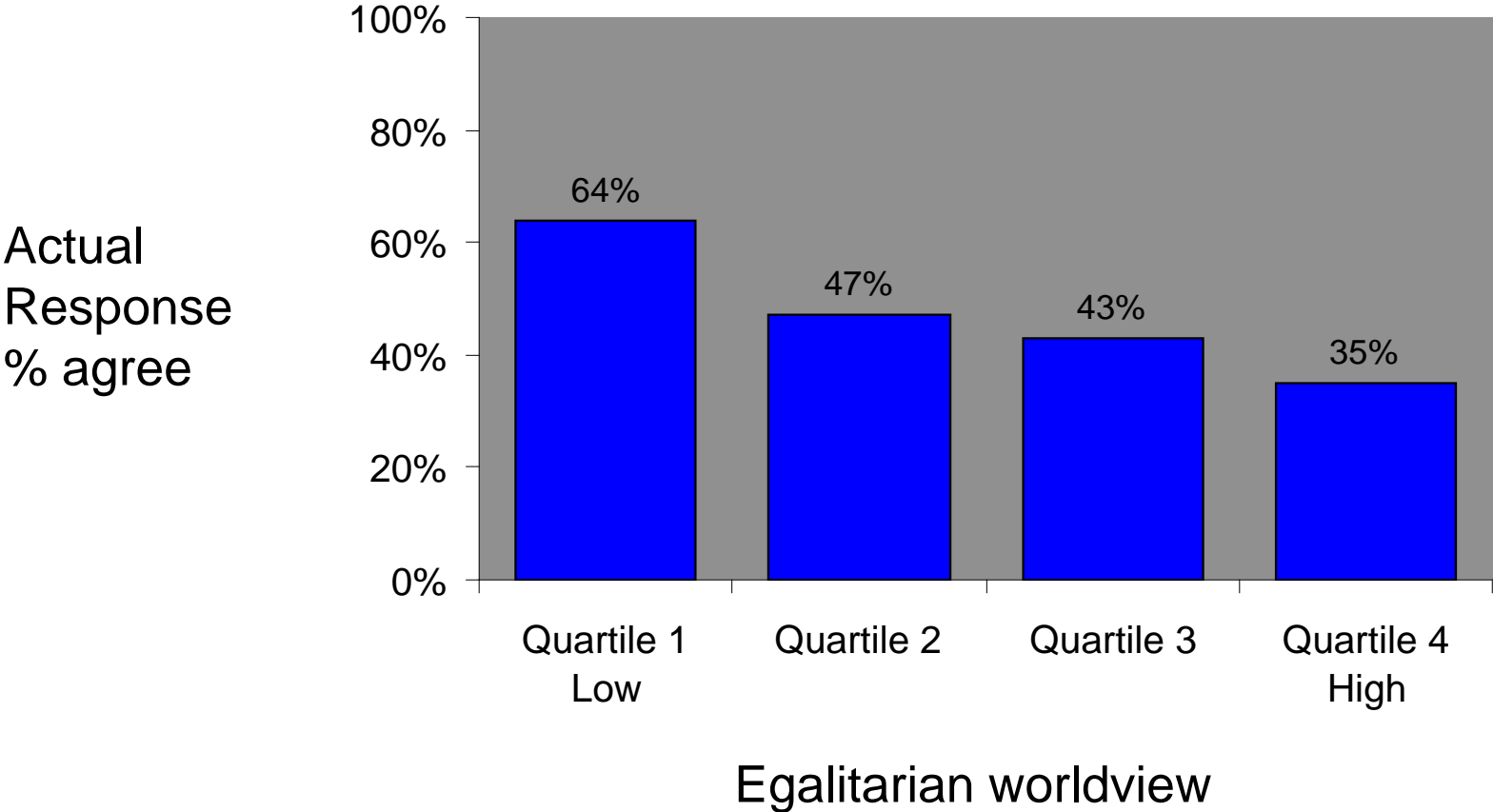
## Culture determines salient values

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- Douglas & Wildavsky (1982):  
Every cultural group attends to some risk and ignores other to maintain a particular way of life.
  - **Hierarchist** (support superior/subordinate social relations and detest civil disobedience)
  - **Individualists** (support self-regulation, individual achievement and reward and dislike social rules that constrain individual initiative)
  - **Egalitarians** (support broad distribution of power and wealth and dislike ranked role differentiation)
  - **Fatalists** (see nature as capricious and thus uncontrollable)



If your community was faced with a potential shortage for electricity, do you [strongly agree... strongly disagree] that a new nuclear power plant should be built to supply that electricity?



# Intuitive Toxicology

(Kraus, Malmfors, & Slovic)

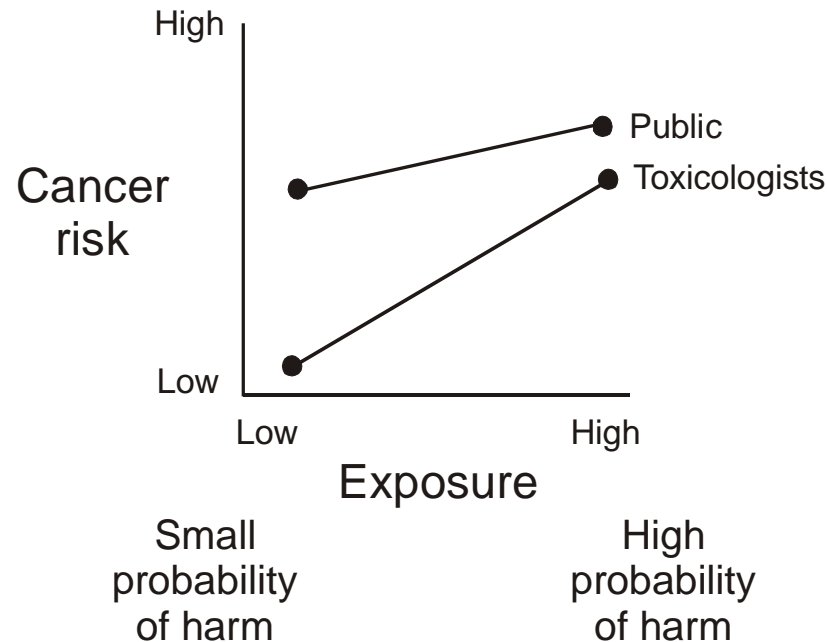
# Intuitive Toxicology Subtopics

- a) conceptions of toxicity, including the toxicity of natural vs. synthetic substances,
- b) effects of chemical concentrations, dose, and exposure on perceptions of risk,
- c) the value of animal studies for predicting toxicity in humans,
- d) interpretation of evidence regarding cause-effect relationships between exposure to chemicals and human health,
- e) confidence in the ability of scientific methods to discover and quantify the toxic effects of chemicals
- f) interpretations of scientific expressions commonly used in reporting chemical risks,
- g) attitudes toward chemical use & regulation.

# Intuitive Toxicology — Main Result

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

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



Dose-response insensitivity is part of a more general neglect of probability when the outcomes are highly emotional(eg, cancer, mad cow disease, terrorism).

Kai Erickson's contamination model of perceived risk and stigma may explain dose insensitivity as well as the strong fear of nuclear and chemical accidents.

Erickson describes the exceptionally dread quality of technological accidents that expose people to radiation and chemicals in ways that

'contaminate rather than merely damage; . . . pollute, befoul, and taint rather than just create wreckage; . . . penetrate human tissue indirectly rather than wound the surface by assaults of a more straightforward kind' (p. 120).

Unlike natural disasters, these radiation and chemical accidents are unbounded. Unlike conventional disaster plots, they have no end.

'Invisible contaminants remain a part of the surroundings — absorbed into the grain of the landscape, the tissues of the body, and worst of all, into the genetic material of the survivors. An 'all clear' is never sounded. The book of accounts is never closed' (p. 121).



Erickson's 'contamination model' may explain the reaction of the public to exposures to carcinogens.

- Numerous studies have found that a high percentage (60-75%) of people believe that if a person is exposed to a chemical that can cause cancer, that person will probably get cancer some day.
- A similarly high percentage believe that 'exposure to radiation will probably lead to cancer some day.'
- The belief that any exposure to a carcinogen is likely to lead to cancer tends to coincide with the belief that it can never be too expensive to reduce such risks.

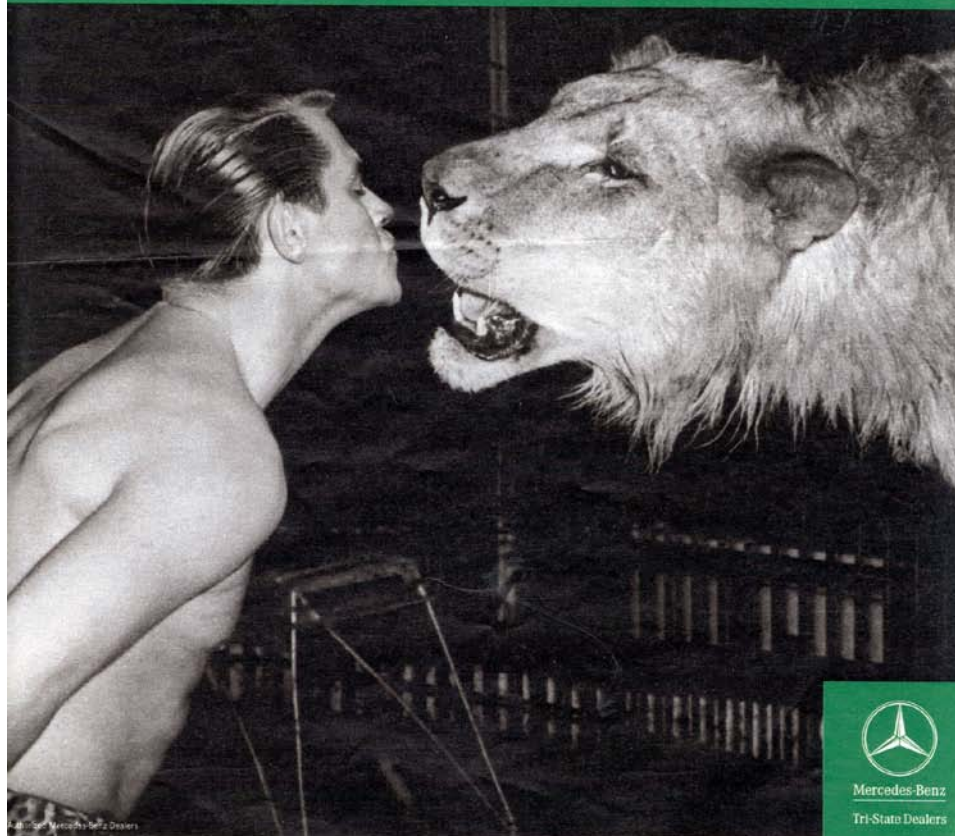
# Lessons from Risk Perception Research

5. Trust is critical and also fragile.

Risk  
and  
Trust

Trust.

(One word rarely used in the same sentence with "car dealer.")



Mercedes-Benz

Tri-State Dealers

# Importance of Trust

“Acceptance of any risk is more dependent on public confidence in risk management than on quantitative estimates of risk”

C. Starr

# TRUST is the Key to Communication Problems

- If you have trust the path is smooth
- If you do not have trust, no form of phrasing or presentation is likely to be successful

# Trust Is Fragile

“If you *once* forfeit the confidence of your fellow citizens, you can *never* regain their respect and esteem”

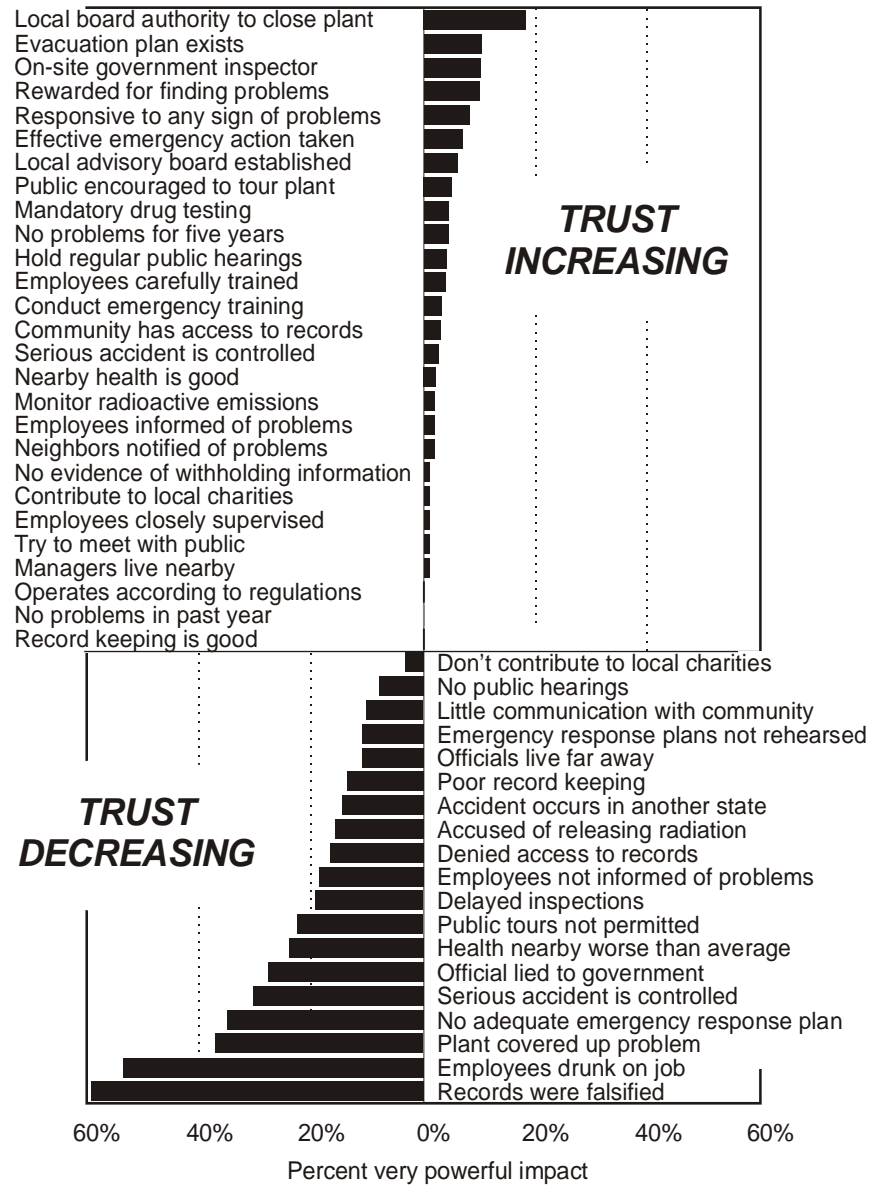
A. Lincoln

# Trust: The Asymmetry Principle

It is far easier to destroy trust than to create it!

- Negative events are more sharply defined (accidents, lies)
- Positive events are often fuzzy or indistinct  
e.g., how many positive events are represented by the safe operation of a nuclear power plant for one day?
- Negative (trust-destroying) events outweigh positive events

# Results



Differential Impact of Trust-Increasing and Trust-Decreasing Events



## Results

	Impact			
	Very small		Very powerful	
	1	2 . . . 6	7	
The county medical examiner reports that the health of people living near the plant is <i>worse</i> than the average for the region	3.0	8.0	26.0	24.0
The county medical examiner reports that the health of people living near the plant is <i>better</i> than the average for the region	21.5	14.0	16.1	2.2

	Impact			
	Very small		Very powerful	
	1	2 . . . 6	6	7
The plant is found to lack an adequate emergency response plan	1.0	1.9	19.4	35.0
There is an emergency evacuation plan for the people living near the plant	19.5	10.3	8.1	10.3

## **Part II**

# **Risk As Analysis and Risk As Feelings**

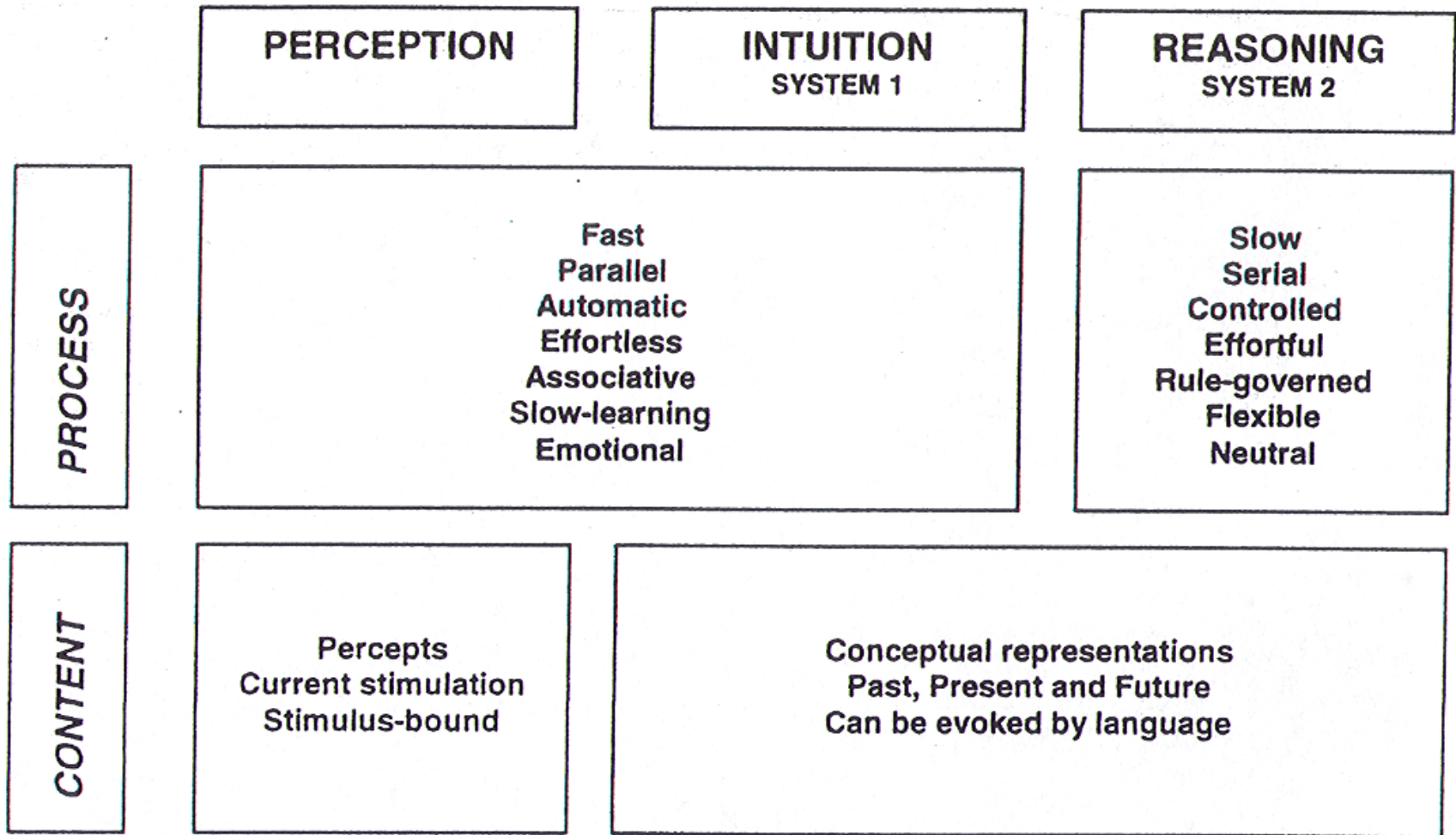
# Risk As Analysis vs. Risk as Feelings

Analytic/  
Deliberative

Experiential/  
Affective



# Process and Content in Two Cognitive Systems



Source: Kahneman, 2003

Risk primarily resides in us as a “gut feeling”.

# Neuron

Volume 36 Number 2



Special Review Issue on

## Reward and Decision

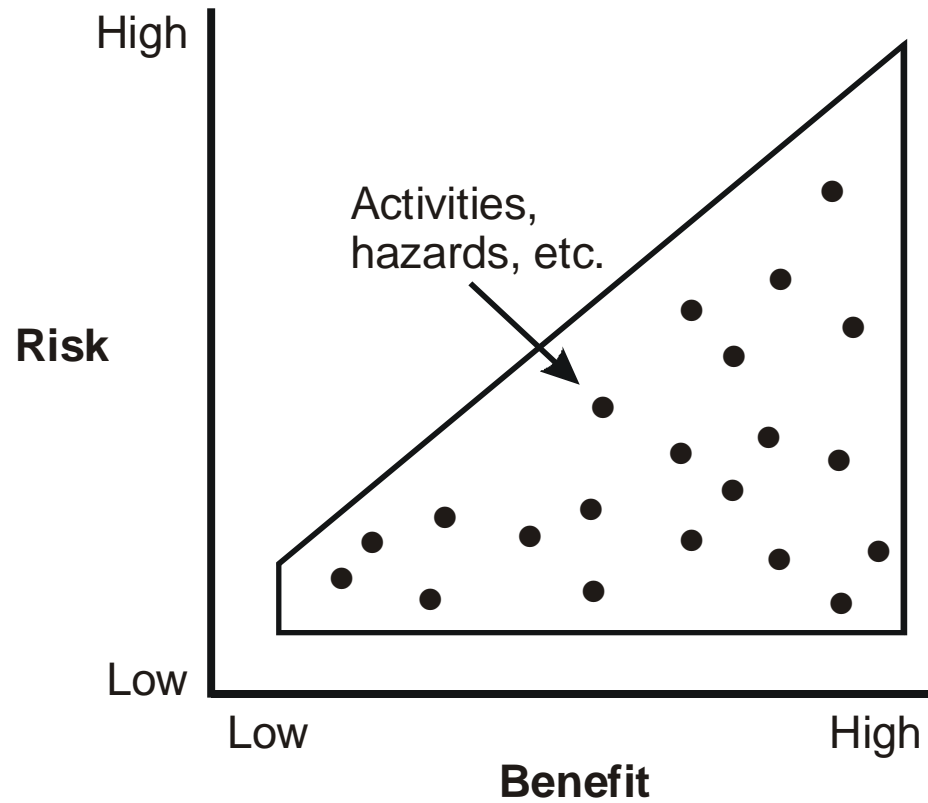
# Neural Economics P. Read Montague (Baylor College of Medicine)

- Survival is about economic evaluation
- The brain is an economic evaluation engine
- The core of neural economics is the recognition that rapid, ongoing economic evaluation is a central... function carried out by the nervous systems of mobile creatures.
- Without some kind of internal currency in the nervous system, a creature would be unable to assess the relative value of events like drinking water, searching for predators, or chasing prey. The nervous system must estimate the value of each of these actions and convert it to a common scale. Recent work has shown that fluctuations in the delivery of the neurotransmitter dopamine may represent one such **common currency**.
-



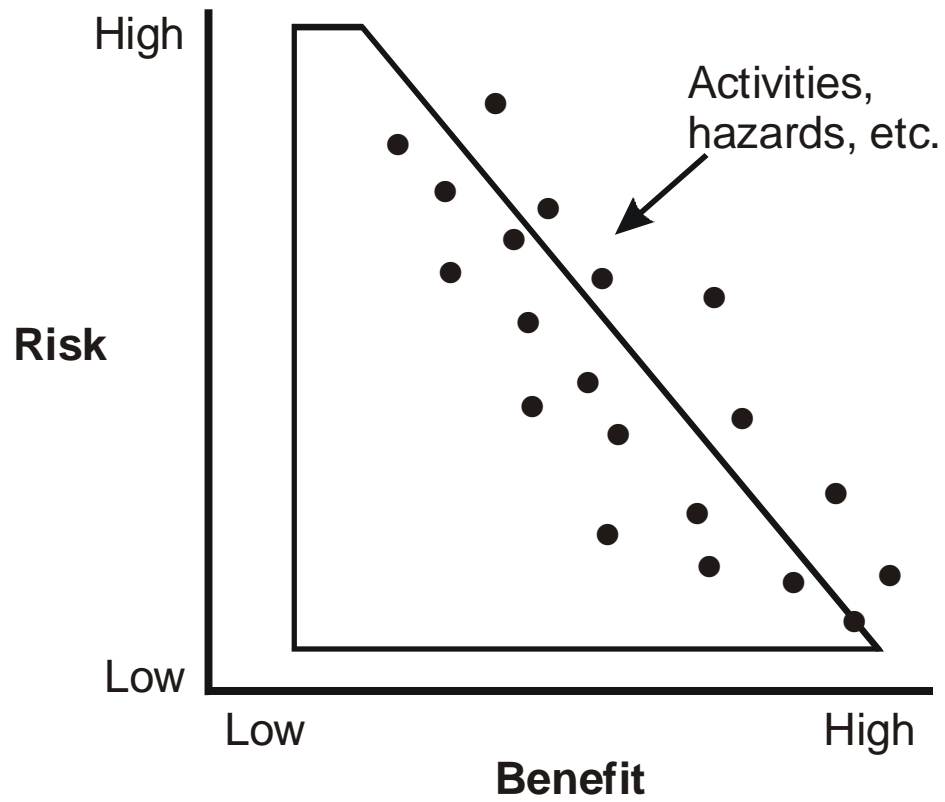
At the psychological level  
this “common currency”  
may be affect:

A valenced quality (e.g., goodness  
or badness) associated  
with a stimulus

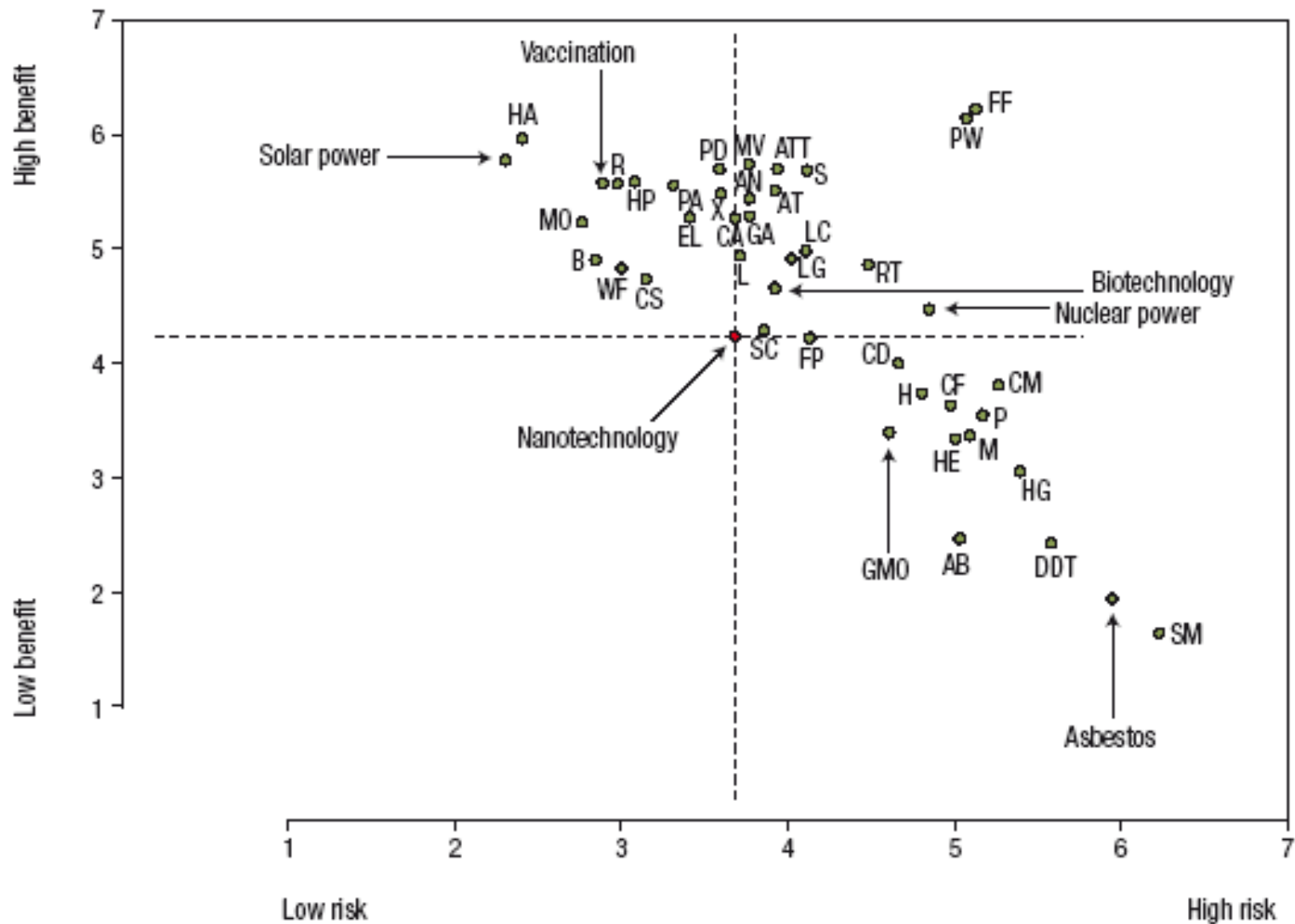


In the world, risk and benefit are **positively** correlated.

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

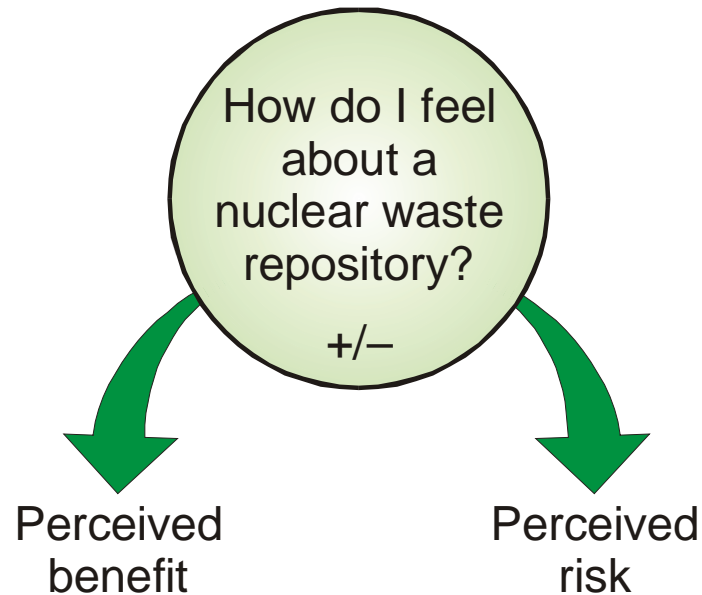


Relationship between risk and benefit in people's minds



**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

# The Affect Heuristic



A model of the affect heuristic explaining the risk/benefit confounding observed by Alhakami and Slovic (1994). Judgments of risk and benefit are assumed to be derived by reference to an overall affective evaluation of the stimulus item.

# Study 1: Risk and Benefit Judgments under Time Pressure

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- ◆ Time pressure reduces opportunity for analytic deliberation, and increases reliance on affect
- ◆ Prediction: Under time pressure people are more likely to use the *affect heuristic* to make judgments.

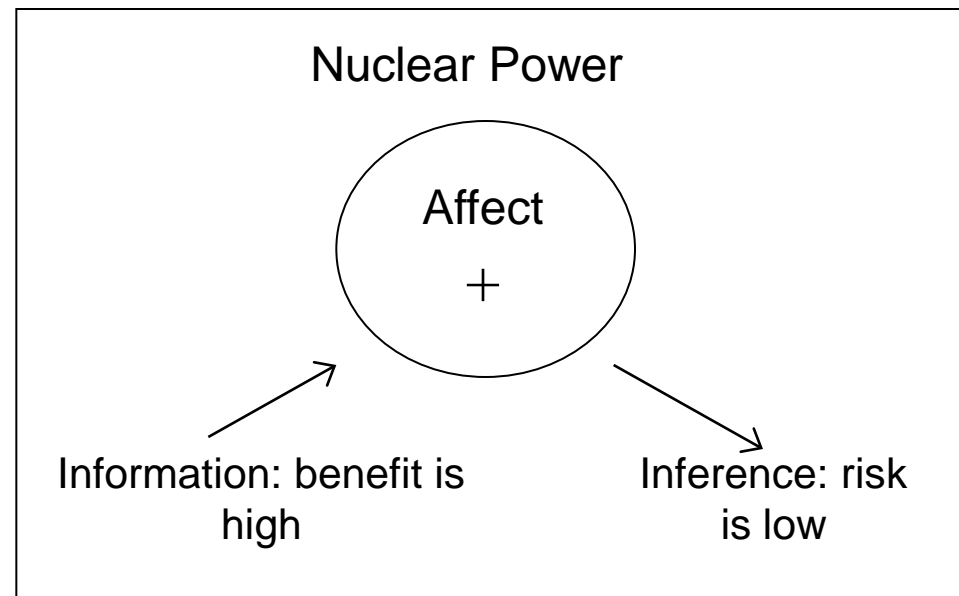


Result: Time pressure increases the inverse relationship between risk and benefit.

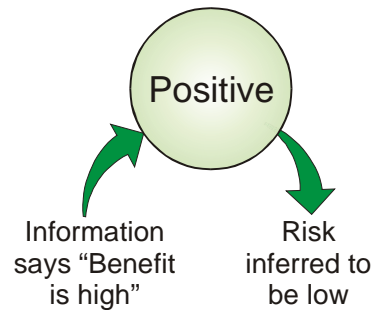
## Study 2: Manipulating Affect by Providing Risk and Benefit Information

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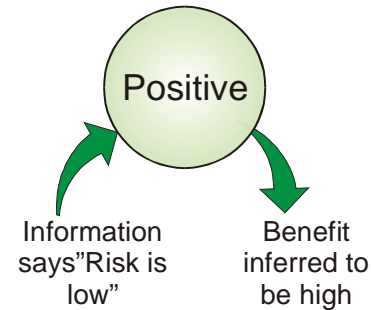
Technique: provide information to change overall impression, e.g., create a more favorable affective evaluation of nuclear power with info that it has high benefit. Perceived risk should then decrease.



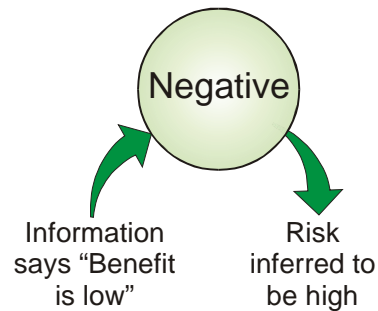
A Nuclear Power



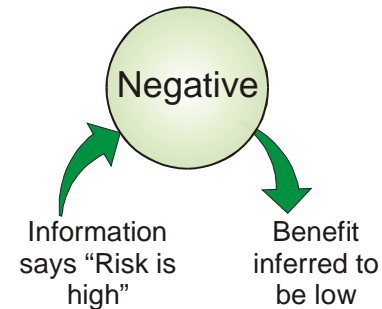
B Nuclear Power



C Nuclear Power



D Nuclear Power



Model showing how information about benefit (A) or information about risk (B) could increase the overall affective evaluation of nuclear power and lead to inferences about risk and benefit that coincide affectively with the information given. Similarly, information could decrease the overall affective evaluation of nuclear power as in C and D.

Source: Finucane et al. (2000).

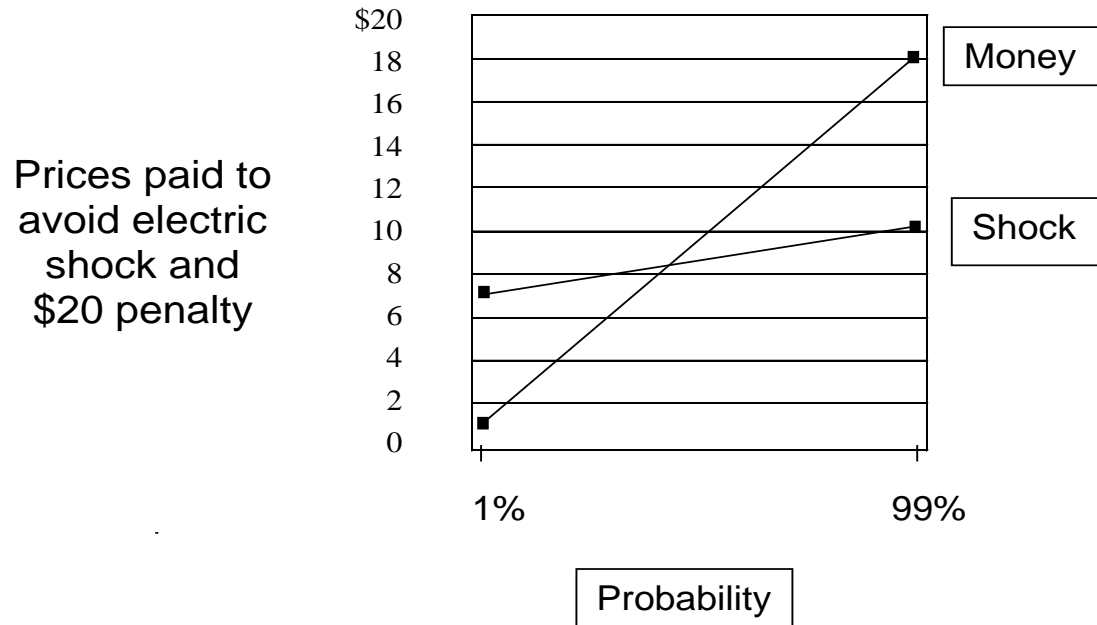


Question:

We have just seen evidence that risks and benefits are confounded in people's minds. What might this mean for risk communication and decision making?

My focus next will be the role of affect  
in the processing of **numerical** information.

# Strong Affect Overcomes Probability



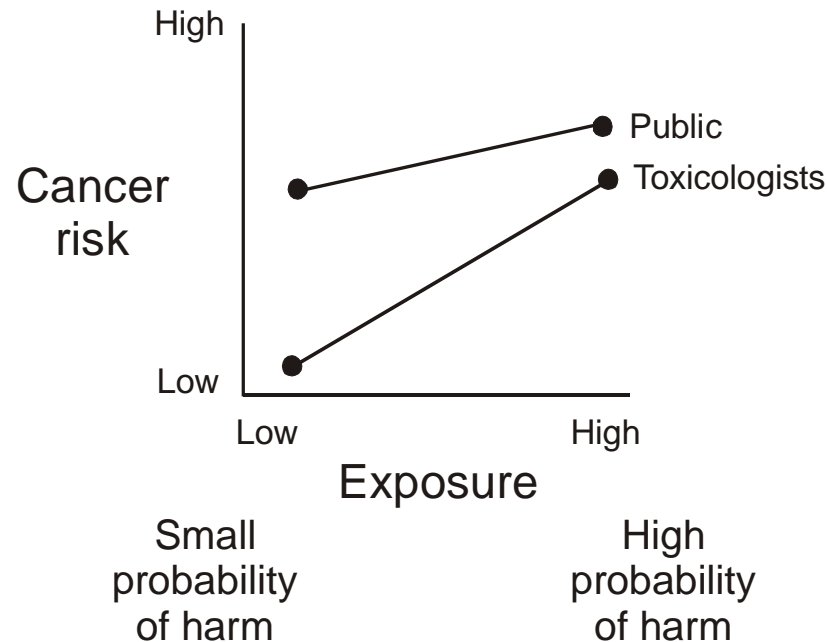
Payment to avoid a chance of electric shock is not much affected by probability

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

# Intuitive Toxicology — Main Result

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

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



# Terrorism and Probability Neglect

Cass R. Sunstein

*The Journal of Risk and Uncertainty*, 26(2/3); 121-136, 2003

- People are prone to . . . *probability neglect*, especially when their emotions are intensely engaged. Probability neglect is highly likely in the aftermath of terrorism. People fall victim to probability neglect if and to the extent that the intensity of their reaction does not greatly vary even with large differences in the likelihood of harm. 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.
- Implications for possible risks from chemicals.

# Another Example of the Affect Heuristic

## Probability and Relative Frequency in Risk Communication

- Are they the same or different in communicating risk?

e.g., 1% chance

vs.

1 out of 100

Work with John Monahan, Ellen Peters, & Don MacGregor.

## **RISK COMMUNICATION:**

A patient – Mr. James Jones – has been evaluated for discharge from an acute civil mental health facility where he has been treated for the past several weeks. A psychologist whose professional opinion you respect has done a state-of-the-art assessment of Mr. Jones. Among the conclusions reached in the psychologist's assessment is the following:

### **EITHER:**

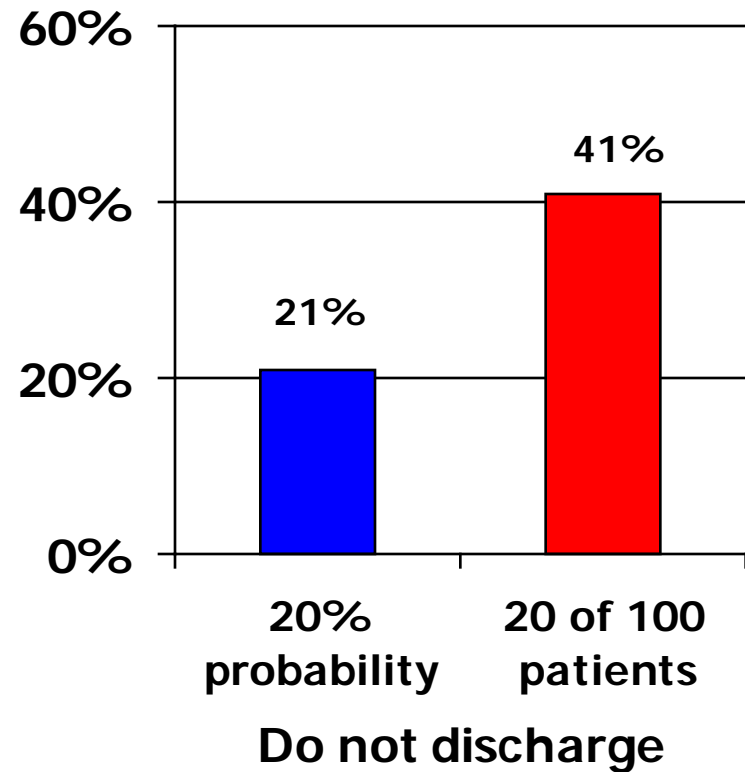
Patients similar to Mr. Jones are estimated to have a 20% probability of committing an act of violence to others during the first several months after discharge.

### **OR:**

Of every 100 patients similar to Mr. Jones, 20 are estimated to commit an act of violence to others during the first several months after discharge.

# Question:

- If you were working as a supervisor at this mental health facility and received the psychologist's report, would you recommend that Mr. Jones be discharged from the hospital at the present time?





# Patient Evaluation

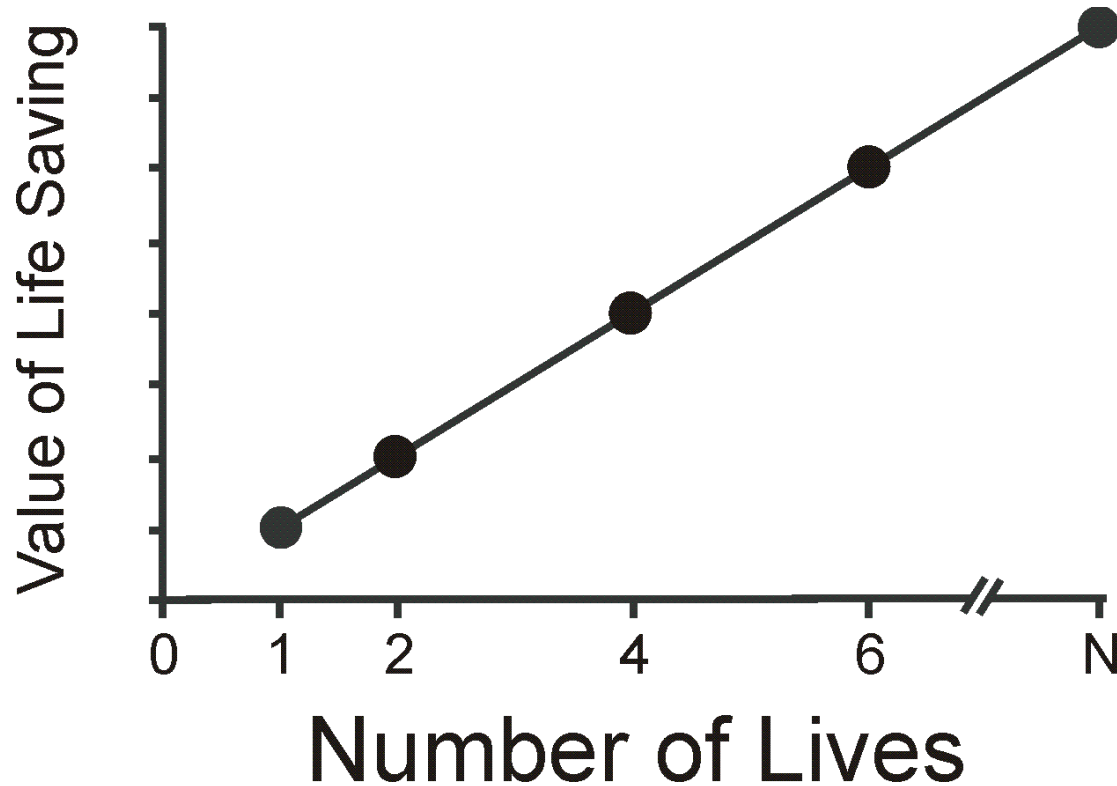
**10%**

- Very few people are violent
- 10% = 1/10
- Probably won't hurt anyone, though

**1 out of 10**

- He could be the 1 out of 10
- Some guy going crazy and killing people
- The patient attacking someone
- An act of violence
- There has to be at least 1 in 10. Mr. Jones could very well be that 1

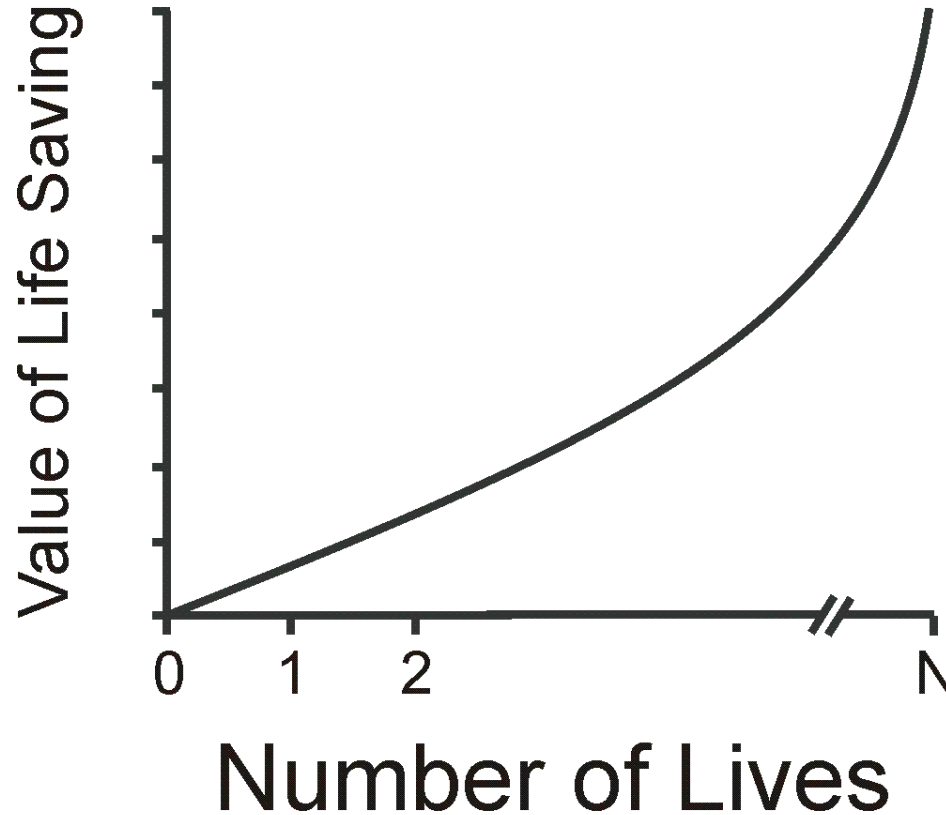
# How Should We Value the Saving of Human Lives?



A normative model:

Every human life is of equal value

# How Should We Value the Saving of Human Lives?



Another normative model: Large losses threaten the viability of the group or society

**But our actions in the face of mass murder  
do not follow either of these normative models.  
Our feelings override our analytic judgments!**

# Insensitivity to the Value of Human Life: A Study of Psychophysical Numbing

DAVID FETHERSTONHAUGH

*Department of Psychology, Stanford University, Stanford, California 94305-2130 (415) 725-5487; fax (415) 725-5699; email [df@psych.stanford.edu](mailto:df@psych.stanford.edu)*

PAUL SLOVIC

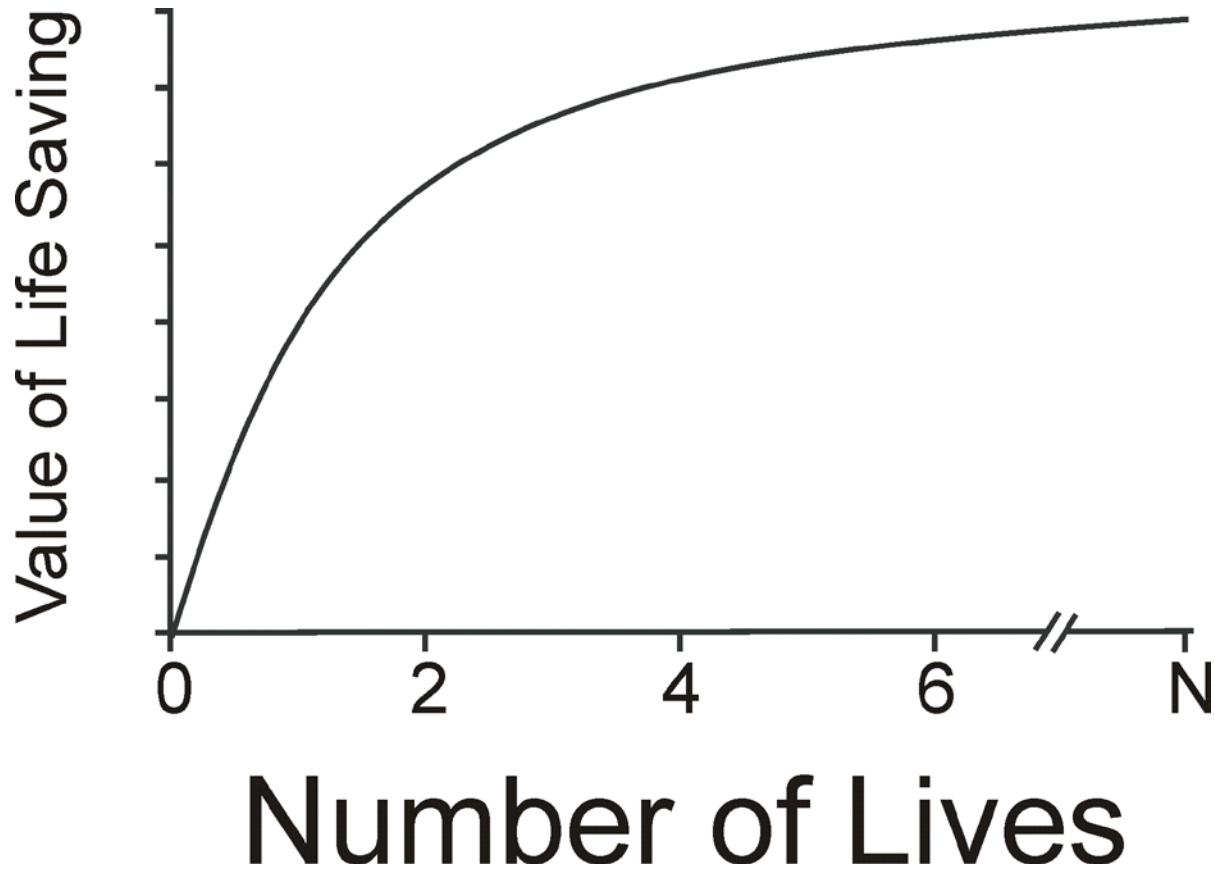
*University of Oregon and Decision Research, Eugene, Oregon*

STEPHEN M. JOHNSON

*Decision Research*

JAMES FRIEDRICH

*Willamette University*



A descriptive model of diminished sensitivity as  $N$  grows large. All lives are not valued equally.  
(psychophysical numbing)

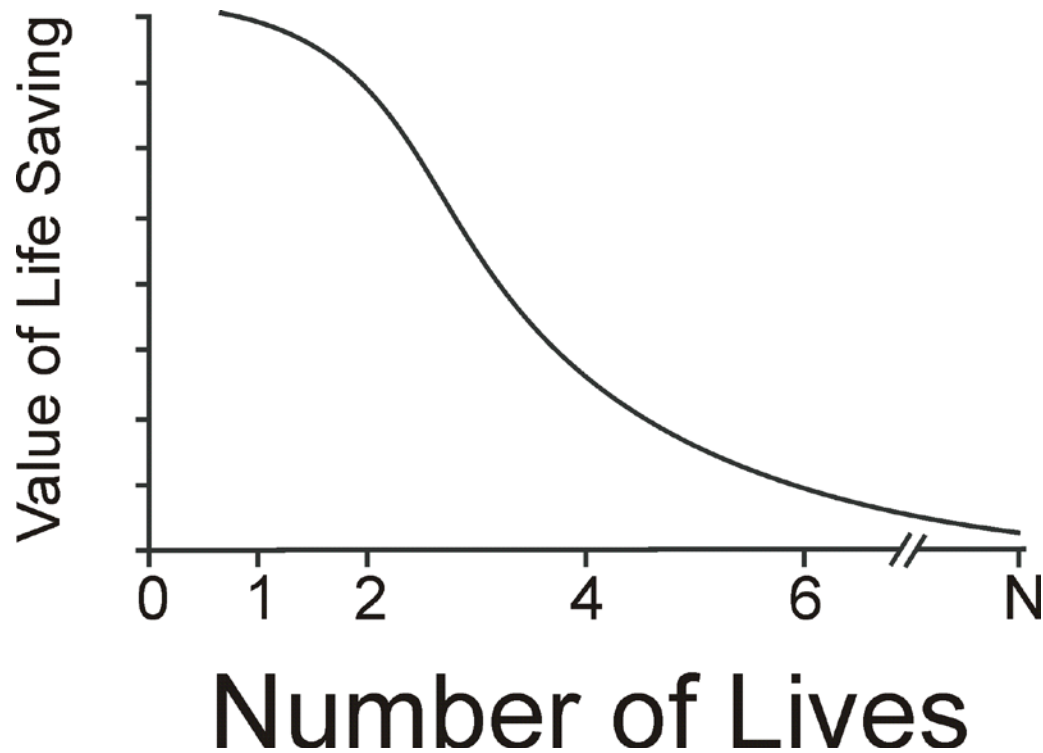












Another descriptive model: **The collapse of compassion.** Our capacity to feel (good or bad) is limited. Valuation depends on feelings (the affect heuristic). Lack of feeling (value) leads to inaction as large losses of life occur in episodes of mass murder or genocide.

# Hunches and Risk Perception

The United States military has spent billions on hardware, like signal jamming technology, to detect and destroy what the military calls improvised explosive devices, or I.E.D.'s, the roadside bombs that have proved to be the greatest threat in Iraq and now in Afghanistan, where Sergeant Tierney is training soldiers to foil bomb attacks.

Still, high-tech gear, while helping to reduce casualties, remains a mere supplement to the most sensitive detection system of all – the human brain. Troops on the ground, using only their senses and experience, are responsible for foiling many I.E.D. attacks, and, like Sergeant Tierney, they often cite a gut feeling or a hunch as their first clue.

Everyone has hunches – about friends' motives, about the stock market, about when to fold a hand of poker and when to hold it. But United States troops are now at the center of a large effort to understand how it is that in a life-or-death situation, some people's brains can sense danger and act on it well before others' do.

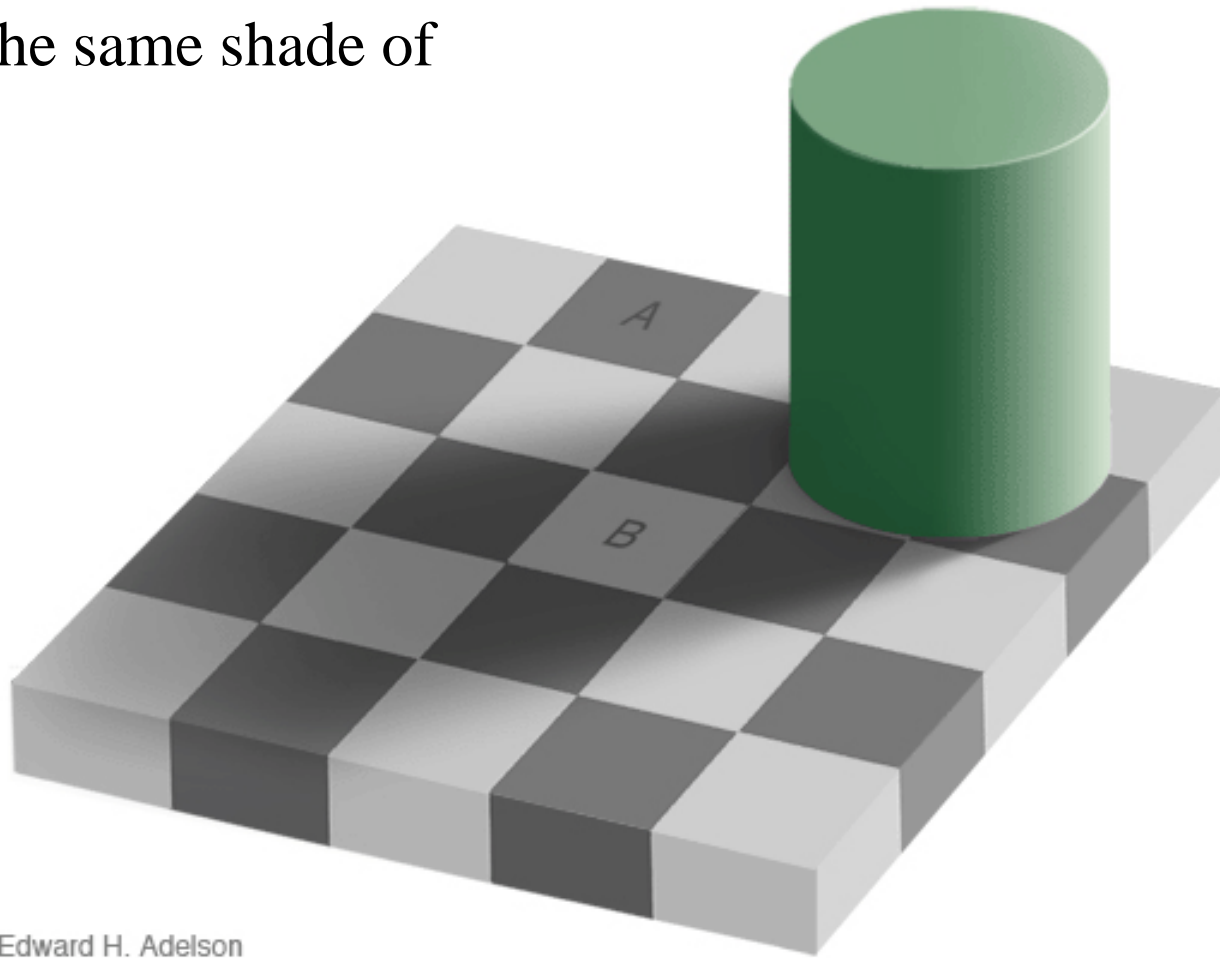
The study complements a growing body of work suggesting that the speed with which the brain reads and interprets sensations like the feelings in one's own body and emotions in the body language of others is central to avoiding imminent threats.

“Not long ago people thought of emotions as old stuff, as just feelings – feelings that had little to do with rational decision making, or that got in the way of it, “ said Dr. Antonio Damasio, director of the Brain and Creativity Institute at the University of Southern California. “Now that position has reversed. We understand emotions as practical action programs that work to solve a problem, often before we're conscious of it. These processes are at work continually, in pilots, leaders of expeditions, parents, all of us.”

## Moral intuition is like perception

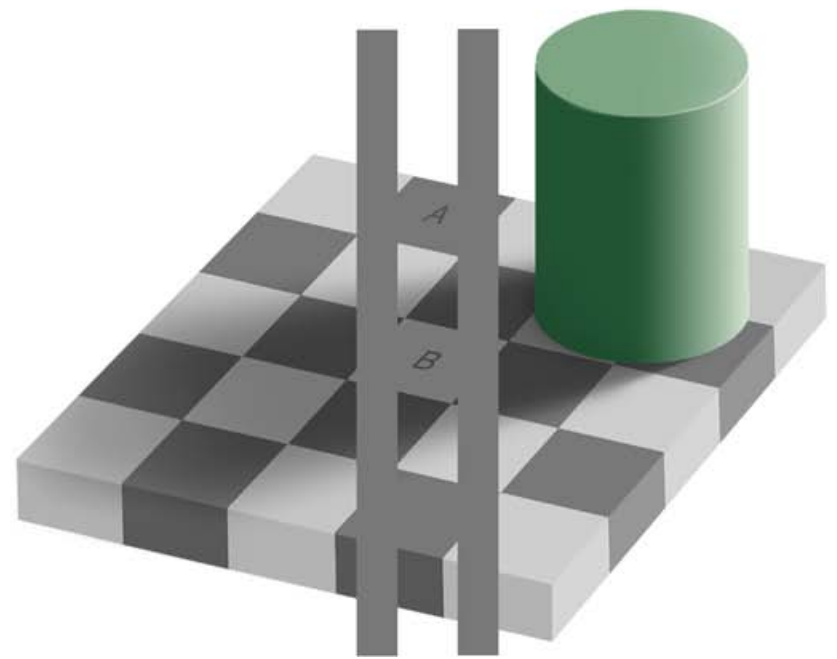
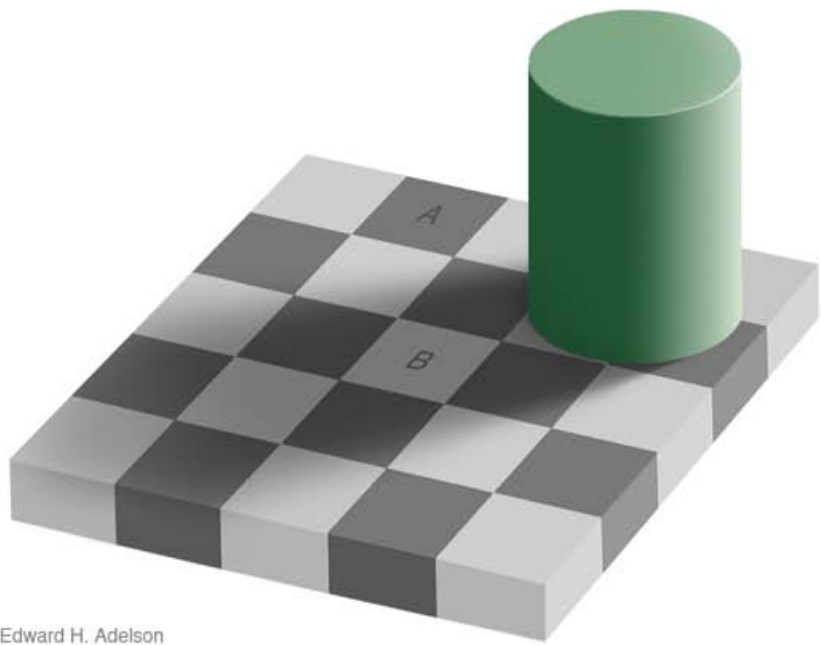
- Visual perception is sophisticated and remarkably accurate
- But perception is subject to powerful systematic biases

The squares marked A and B are the same shade of gray.



Edward H. Adelson





Edward H. Adelson

- Intuitive judgment, like perception, is sophisticated, accurate, and sometimes very biased

## The Police Officer's Dilemma: Using Ethnicity to Disambiguate Potentially Threatening Individuals

Joshua Correll, Bernadette Park,  
and Charles M. Judd  
University of Colorado at Boulder

Bernd Wittenbrink  
University of Chicago

Using a simple videogame, the effect of ethnicity on shoot/don't shoot decisions was examined. African American or White targets, holding guns or other objects, appeared in complex backgrounds. Participants were told to "shoot" armed targets and to "not shoot" unarmed targets. In Study 1, White participants made the correct decision to shoot an armed target more quickly if the target was African American than if he was White, but decided to "not shoot" an unarmed target more quickly if he was White. Study 2 used a shorter time window, forcing this effect into error rates. Study 3 replicated Study 1's effects and showed that the magnitude of bias varied with perceptions of the cultural stereotype and with levels of contact, but not with personal racial prejudice. Study 4 revealed equivalent levels of bias among both African American and White participants in a community sample. Implications and potential underlying mechanisms are discussed.



# AVIATION WEEK

## & SPACE TECHNOLOGY

### New Systems Upgrade Primary Flight Training

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# Echoes of Challenger

Evidence is growing that NASA's failure to fully implement lessons from the earlier accident played a key role in the loss of Columbia

- One of the problems was that a lack of hard data prevented the input of more common sense analysis . . .
- The overriding emphasis on data – the kind of analysis that repeatedly produced “no flight safety risk” assessments involving Columbia’s external tank foam strike – paints NASA decision makers into a corner and fails to take advantage of engineering common sense that may not be backed up by specific data . . .

- ‘intuition and hunch’ do not carry any weight. They do in everyday decision-making. But when it comes to formal decisions, hard data-numbers are required
- . . .the underlying rules are that as engineers you have to have ‘the number’” around which to base assessments, . . . “That basically means every flight becomes ‘data’ and that ‘concerns’ about an anomaly are not data – so a successful flight with an anomaly simply becomes data that say it’s safe to fly.



# How can we improve our intuitive skills?

- create proper learning environments
- recognize and avoid deceptive learning environments
- recognize the strengths and weaknesses of intuitive and deliberative processes
- restructure the task or environment to correct known bias

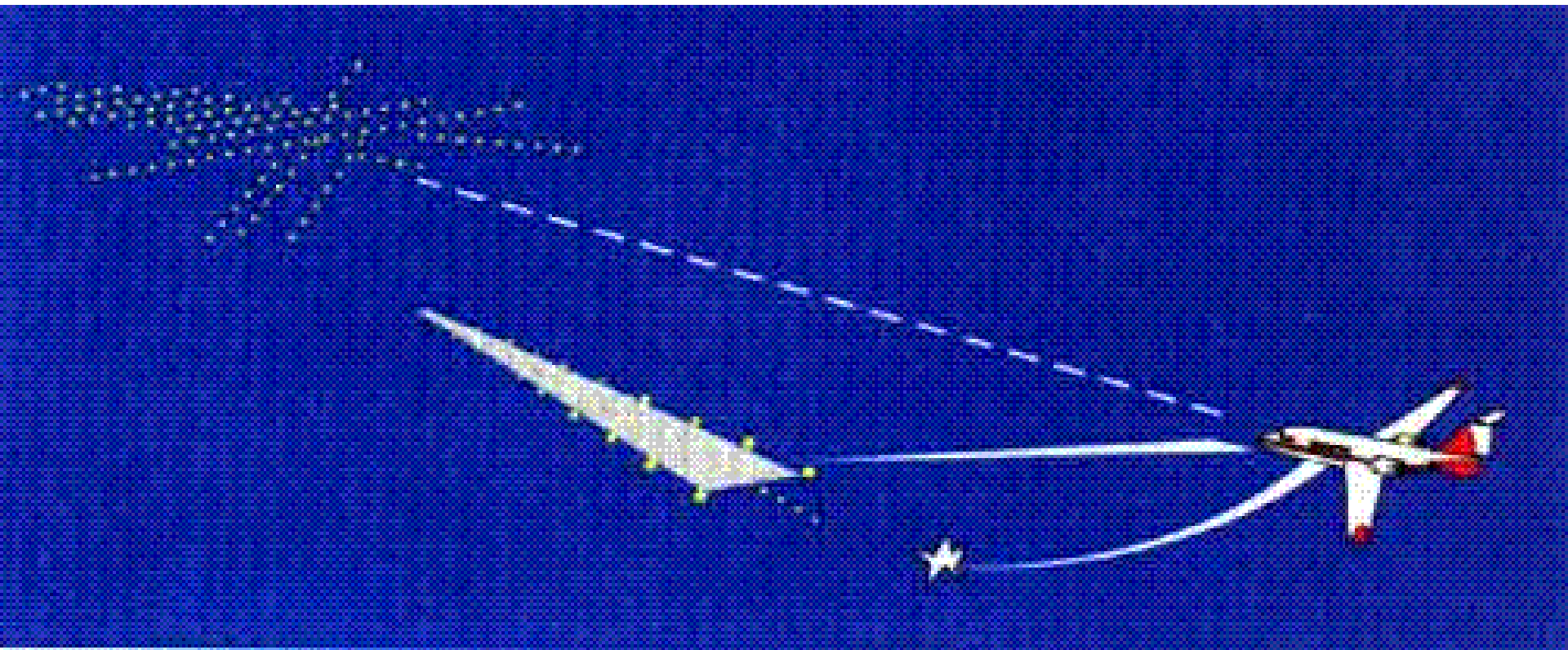
# Visual Perception of Touchdown Point During Simulated Landing

Stephen Palmisano  
University of Wollongong

Barbara Gillam  
University of New South Wales

Experiments examined the accuracy of visual touchdown point perception during oblique descents ( $1.5^{\circ}$ – $15^{\circ}$ ) toward a ground plane consisting of (a) randomly positioned dots, (b) a runway outline, or (c) a grid. Participants judged whether the perceived touchdown point was above or below a probe that appeared at a random position following each display. Although judgments were unacceptably imprecise and biased for moving dot and runway displays, accurate and unbiased judgments were found for grid displays. It is concluded that optic flow per se does not appear to be sufficient for a pilot to land an airplane and that the systematic errors associated with optic flow under sparse conditions may be responsible for the common occurrence of landing incidents in so-called “black hole” situations.

*Keywords:* visual landing, optic flow, heading, glideslope



# Conclusions

- The analytic and experiential (affective) systems of thought are exquisitely sophisticated and embody the essence of human rationality.
- Both systems, however, can lead us astray.
- Each system needs the other for guidance.
- Effective use of hunches depends on the ability to know when they work well and when they don't.