Week 10-1 Tuesday Session

Pre-class activity: write down an estimate your score on the Friday, Critical Reasoning Quiz (Number of points out of 75) excluding extra credit

Am Session:

Review of Quiz

Reasoning about risk discussion

Critical Exchange Preparation

Pm Session

Critical Exchange Preparation/ Meeting with David

Estimate your score on the Friday, Critical Reasoning Quiz (Number of points out of 75) excluding extra credit

What is risk?

Risk for our purposes is the probability (chance) that something (bad) will happen.

Risk is a concept that denotes a potential negative impact to some characteristic of value that may arise from a future event, or we can say that "Risks are events or conditions that may occur, and whose occurrence, if it does take place, has a harmful or negative effect". Exposure to the consequences of uncertainty constitutes a risk. In everyday usage, *risk* is often used synonymously with the probability of a known loss.

How risky is it?

Average Deaths Per Year:
1,000 on a bicycle
1,452 by accidental gunfire
3,000 by complications to medical procedures
3,600 by inhaling or ingesting objects
5,000 by drowning
8,000 as pedestrians
46,000 in auto accidents
SOURCES: Estimates courtesy of Bureau of Safety Statistics, National Transportation Safety Board

How do we determine is risk?

How do we determine the probability that something bad will happen.

Standard notion of probability is relative frequency of the event the proportion of occurrence

For example (from Bureau of Safety Statistics),

p(nontransportation unintentional—accidental-death 2004 in US) =

proportion of such deaths04/ number of people (in US)

63,959/293,656,842 = .0002   roughly 2/10000

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Odds Talk = what were the odds of dying from a nontransportation unintentional—accidental cause)? Expressed as 1 in ???

$$\frac{63,959}{63,959} \Big/ \frac{293,656,842}{63,959} = \frac{1}{4591}$$

One year odds of dying from such accidents is 1 in 4591

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Life time odds of dying from such accidents

 divide the one year odds/ yeas in life time (life expectancy)

For 2004 life expectancy is 77.9 years

    4591/77.9 years ≈ 59

So life time odds of such an accident death is 1 in 59

Issues in reasoning about risk

What is risk?

Calculating risk

Optimism Bias

Communication about Risk

Arnold Barnett,

MIT Sloan School

Expert on
Aviation Safety

Risks in Everyday life: ultimate risks

" NTSB studies show that, from 1993 through 1996, scheduled US carriers averaged only 0.2 fatal accidents per 100,000 flight hours, less than half the fatal-accident rate for the four year period a decade earlier."

   ---WALL STREET JOURNAL, 8/11/97

Percentage of accidents/fatalities

	Taxi, load, parked	Takeoff	Initial climb	Climb (flaps up)	Cruise	Descent	Initial approach	Final approach	Landing
		17%						51%	
Accidents	5%	12%	5%	8%	6%	3%	7%	6%	45%
Fatalities	0%	8%	14%	25%	12%	8%	13%	16%	2%
		22%						18%	
		1%	1%	14%	57%	11%	12%	3%	1%

Exposure = percentage of flight time based on flight duration of 1.5 hours

MORTALITY RISK MEASURE

If a passenger chooses a flight at random
from among those of interest (e.g. U.S.
domestic jets over 1990 - 1995), what is the
probability that he will be killed during the
flight?

This death risk per flight statistic is easy
to calculate and has conceptual advantages.

DEATH RISK PER FLIGHT ON U.S. DOMESTIC JETS IN TWO SUCCESSIVE DECADES

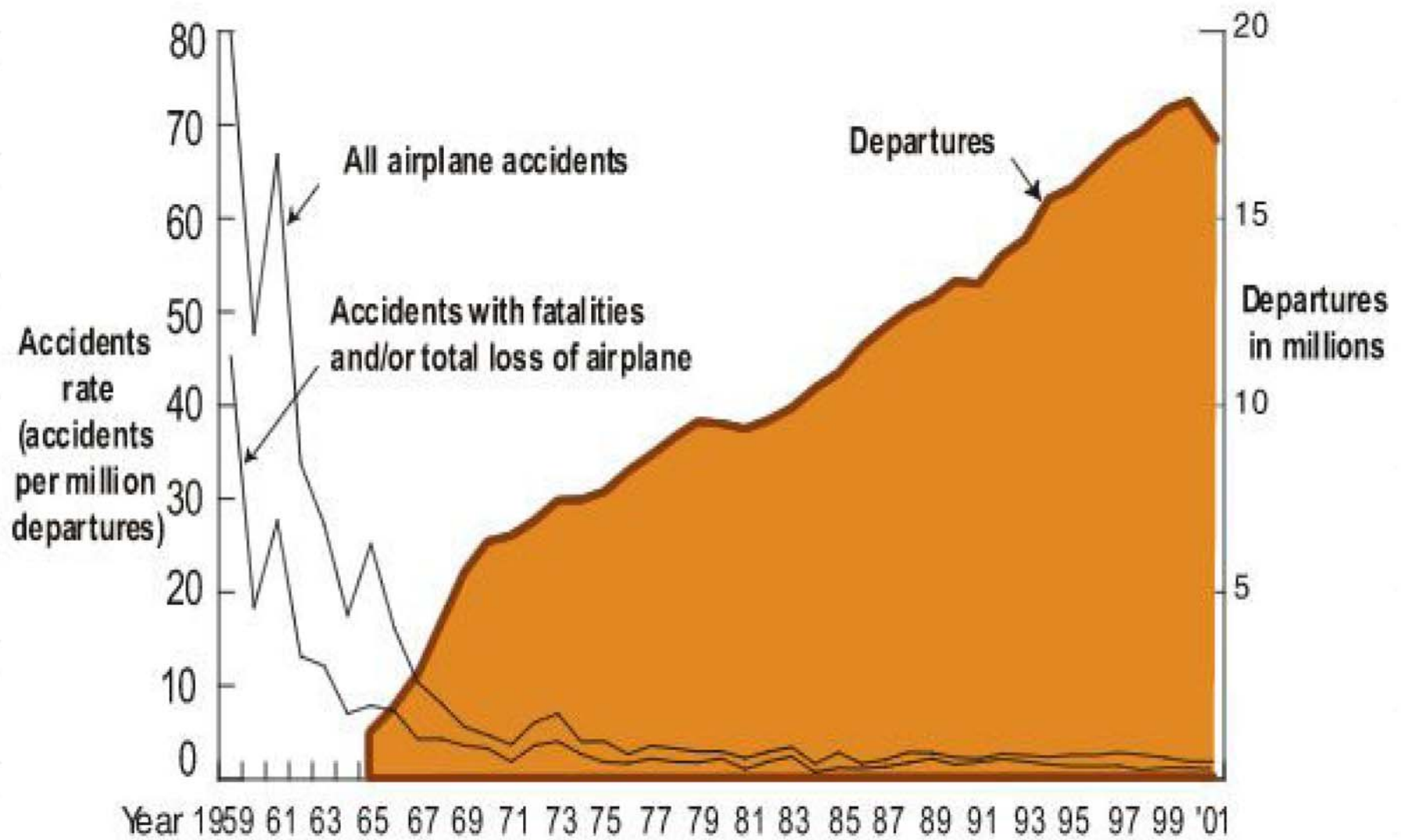| - Period	Death Risk Per Flight
- 1976-86	1 in 7 Million
- 1987-96	1 in 7 Million
-1997-2007	1 in 248,817

AT THAT LEVEL OF RISK:

If a passenger chose one flight at random each day, she would on average go for 19,000 years before succumbing to a fatal crash.

682 years @ 1/248817

DEATH RISK PER U.S. DOMESTIC COMMUTER FLIGHT, 1987-96:

1 in 2.5 million

Is the drive to and from the airport the most dangerous part of a journey by air?

Death Risk per <u>100</u> Miles
for a "Safe" Driver:

1 in 10 Million

Assuming 30 miles of travel to and from the airport, the total mortality risk in the car is about:

1 in 30 Million

(This number is only 1/4 as high as the risk of a jet flight.)

Rule of Thumb:

For every hour you save by traveling by jet rather than car, there is a bonus:

A <u>67-second increase</u> in life expectancy tied to choosing the safer form of travel.

HOW IMPORTANT IS NEW YORK'S RECENT DROP IN MURDERS TO THE SAFETY OF RESIDENTS OF THAT CITY?

NEW YORK CITY:

1990–2200 homicides

1997–800 homicides
(estimated)

2007 ≈ 500 homicides

New York City's population is about 7.5 million. Thus, based on 2200 killings per year, the annual murder risk to a randomly-chosen citizen would be about:

2200/7.5 Million, or

ROUGHLY 1 in 3400

Over a life span of 70 years, the cumulative murder risk for a citizen would be about:

70 X (1 in 3400), or

approximately 1 in 49 (!!)

But, at the reduced level of 800 killings per year, the corresponding lifetime murder risk would be approximately:

1 in 134

**And at the 2007 rate of 500 killings per year
1 in 237**

Subtracting 1 in 134 from 1 in 49, we reach a conclusion:

New York City's drop in murder, IF SUSTAINED, means that

1 in 77

New Yorkers born this year would eventually have been slain under the 1990 risk pattern BUT will be spared under the 1997 pattern.

And spared under the 2007 pattern

1 in 62

HOW MUCH DOES SMOKING CIGARETTES INCREASE A PERSON'S RISK OF LUNG CANCER?

Statistic:

Cigarette smokers include about 40% of American adults and 85% of American lung-cancer sufferers.

What is the lung cancer risk
of cigarette smokers relative
to that of non-smokers?

LET Q = NUMBER OF AMERICANS WHO GET LUNG CANCER PER YEAR

N = NUMBER OF AMERICAN ADULTS

Then, if the 40% of Americans who smoke get 85% of the lung-cancer cases, their annual lung-cancer rate is:

$$.85Q/(.4N) \quad = \quad 2.25 \ (Q/N)$$

The corresponding rate for non-smokers is:

$$.15Q/(.6N) \ = \ .25 \ (Q/N)$$

In short, cigarette smokers would have NINE (2.25/.25) times the annual lung-cancer rate as non-smokers.

WAS VIETNAM A "CLASS WAR" IN WHICH AMERICAN DEATHS WERE OVERWHELMINGLY CONCENTRATED AMONG THE POOR AND WORKING CLASS?

The war would have ended sooner if "the mothers of Beverley Hills and Chevy Chase and Great Neck and Belmont were on the phones to their Congressmen screaming "you killed my boy.'

--James Fallows

DEATHS IN VIETNAM IN FOUR UPSCALE US COMMUNITIES, AS PROJECTED FROM NATIONAL PER-CAPITA DEATH RATES AND BASED ON ACTUAL NUMBERS:
VIETNAM CASUALTIES:

COMMUNITY	PROJECTED	ACTUAL
CHEVY CHASE, MD	4.7	7
BEVERLY HILLS, CA	9.4	6
GREAT NECK, NY	4.8	5
BELMONT, MA	8.0	11

(NATIONAL RATE: 1 VIETNAM DEATH PER 3600 CITIZENS)

ESTIMATED PERCENTAGE OF US VIETNAM WAR DEATHS AMONG
CITIZENS FROM EACH DECILE OF THE NATIONAL US INCOME
DISTRIBUTION:

DECILE	PERCENTAGE OF DEATHS
LOWEST	9.6 (%)
SECOND	13.1
THIRD	11.2
FOURTH	11.8
FIFTH	9.4
SIXTH	10.8
SEVENTH	9.1
EIGHTH	9.2
NINTH	8.0
HIGHEST	7.8

Compare your predicted Quiz score against the actual score

Is predicted less than?   **Pessimistic**   your actual score

Equal to?   **Accurate**

Greater than?   **Optimistic**

Optimism bias is the demonstrated systematic tendency for people to be over-optimistic about the outcome of planned actions. This includes over-estimating the likelihood of positive events and under-estimating the likelihood of negative events. Optimism bias applies to professionals and laypeople alike.

Armor and Taylor review a number of studies that have found optimism bias in different kinds of judgment. These include:

- Second-year MBA students overestimated the number of jobs they would receive and their starting salary.
- Students overestimated the scores they would achieve on exams.
- Almost all the newlyweds in a US study expected their marriage to last a lifetime, even while aware of the divorce statistics.
- Professional financial analysts consistently overestimated corporate earnings.
- Most smokers believe they are less at risk of developing smoking-related diseases than others who smoke.

Students in one study rated themselves as much less likely than their peers (students of the same sex at the same college) to experience negative life events such as developing a drink problem, having a heart attack, being fired from a job or divorcing a few years after getting married.

Psychological account of risk and biases

Cognitive Bias

Framing(Tversky, Amos, and Daniel Kahneman, 1981. "The Framing of Decisions and the Psychology of Choice.") is a fundamental problem with all forms of risk assessment. In particular, because of bounded rationality(our brains get overloaded, so we take mental shortcuts), the risk of extreme events is discounted because the probability is too low to evaluate intuitively. As an example, one of the leading causes of death is road accidents caused by drunk driving—partly because any given driver frames the problem by largely or totally ignoring the risk of a serious or fatal accident.

Emotional Bias

For instance, an extremely disturbing event (an attack by hijacking, or moral hazards may be ignored in analysis despite the fact it has occurred and has a nonzero probability. Or, an event that everyone agrees is inevitable may be ruled out of analysis due to greed or an unwillingness to admit that it is believed to be inevitable.
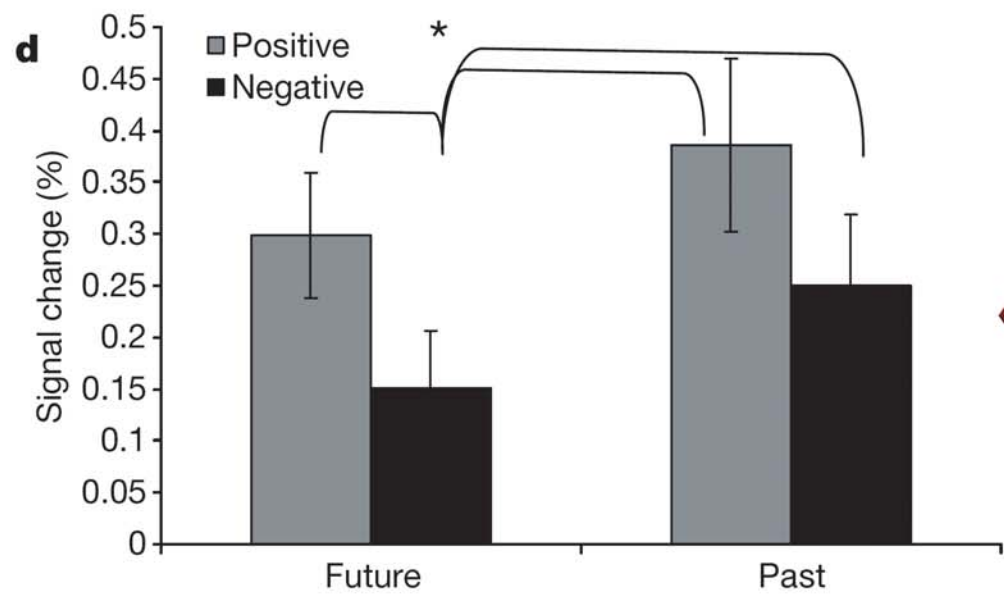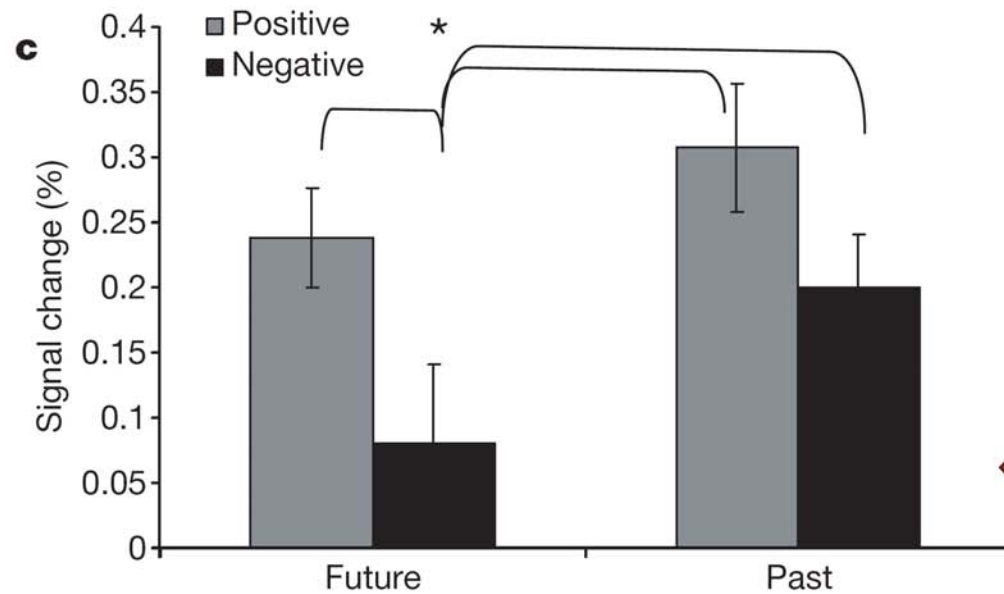
Cultural Bias

All decision-making under uncertainty must consider cognitive bias, cultural bias, and notational bias No group of people assessing risk is immune to "groupthink": acceptance of obviously wrong answers simply because it is socially painful to disagree, where there is conflicts of interest One effective way to solve framing problems in risk assessment or measurement (although some argue that risk cannot be measured, only assessed) is to raise others' fears or personal ideals by way of completeness.
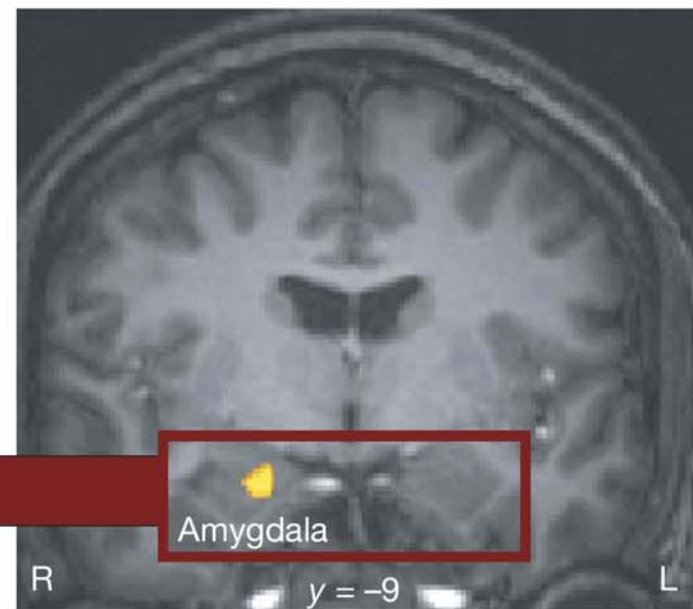
What is the basis of our optimism bias?

Brain-imaging study found that, when imagining negative future events, signals in the amygdala, an emotion center of the brain, are weaker than when remembering past negative events. This weakened consideration of possible negative outcomes is one possible mechanism for optimism bias.
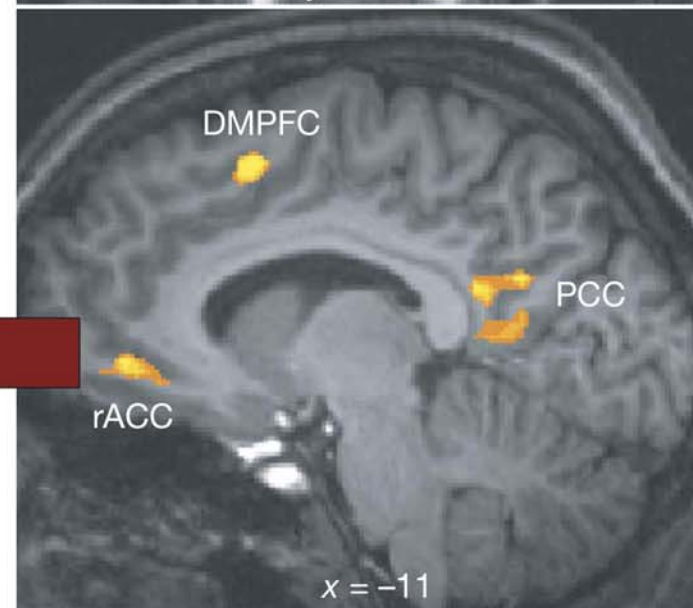
1. Sharot, Tali; Alison M. Riccardi, Candace M. Raio, Elizabeth A. Phelps (2007-10-24). "Neural mechanisms mediating optimism bias". *Nature* **450**: 102-015. doi:10.1038/nature06280. Retrieved on 2008-05-27.

c

Signal change (%)

	Future	Past
Positive	~0.24	~0.31
Negative	~0.08	~0.20

*

d

Signal change (%)

	Future	Past
Positive	~0.30	~0.39
Negative	~0.15	~0.25

*

a

Amygdala

R $y = -9$ L

b

DMPFC

PCC

rACC

$x = -11$

Abstract

Humans expect positive events in the future even when there is no evidence to support such expectations. For example, people expect to live longer and be healthier than average[1], they underestimate their likelihood of getting a divorce[1], and overestimate their prospects for success on the job market[2]. We examined how the brain generates this pervasive optimism bias. Here we report that this tendency was related specifically to enhanced activation in the amygdala and in the rostral anterior cingulate cortex when imagining positive future events relative to negative ones, suggesting a key role for areas involved in monitoring emotional salience in mediating the optimism bias. These are the same regions that show irregularities in depression[3], which has been related to pessimism[4]. Across individuals, activity in the rostral anterior cingulate cortex was correlated with trait optimism. The current study highlights how the brain may generate the tendency to engage in the projection of positive future events, suggesting that the effective integration and regulation of emotional and autobiographical information supports the projection of positive future events in healthy individuals, and is related to optimism.

"It cannot indicate whether the positivity bias is a function of time (that is, it will emerge only when we think about the future) or whether it reflects a tendency to engage in positive thought when not constrained by reality. Speculate …absence of factual constraints "

Is it rational to be unrealistically optimistic?

Optimism bias is clearly not an unnoticed accident - people *want* to be so biased David Armor et.al. "Prescribing Optimism," *Psychological Science*, April 2008

We asked [383] participants to imagine one of four different settings ... [of] decisions about a financial investment, an academic-award application, a surgical procedure, and a dinner party. For each setting, we created eight vignettes [varying] ... commitment ... agency ... and control. One third ... were asked to provide prescriptions ... whether it would be best to be overly pessimistic, accurate, or overly optimistic, ... another third ... to indicate what kind of prediction the protagonist in each vignette would make, and the final third to indicate what kind of prediction they themselves would make. .... Options ranged from -4 (extremely pessimistic) through 0 (accurate) to +4 (extremely optimistic). ....

Overall, the modal prescription was moderately optimistic (+2 on our scale), which was endorsed nearly twice as often as accurate (32.3% vs. 17.7%). .. **Participants [said] ... that [other] people tend to be optimistically biased ... [and] also reported being optimistically biased [themselves].** The degrees of bias participants attributed to other people and to themselves did not differ. ... **Finally, and most strikingly, ... [they said] people should be even more optimistic than they are**. ...

Participants prescribed (and described) more optimism (a) after commitment to a course of action rather than before (b) when the decision to commit was the protagonist's to make rather than not, and (c) when the protagonist's control over the outcome was high rather than low. ... The results were also largely robust across the settings we sampled ... [and] across key measured variables. Interestingly, even participants who were self-identified as pessimists ... prescribed optimism ... Although Asian participants prescribed less optimism than any other ethnic group, they still prescribed optimism.

Optimism bias is clearly not an unnoticed accident - people *want* to be so biased.
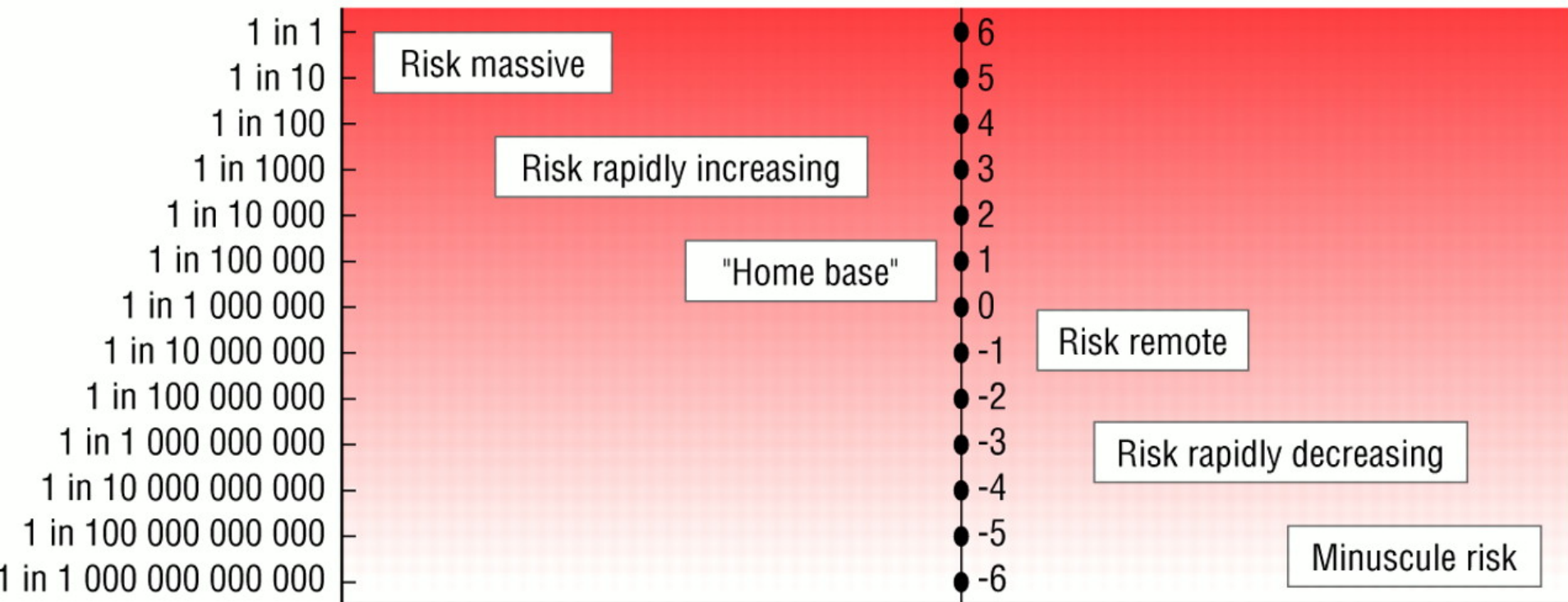
Is it rational to be unrealistically optimistic?

Conclusion "Prescribed Optimism"

"These results suggest that optimistic biases may be more than just unwanted and unintended consequences of motivated reasoning, basic cognitive processes or evolutionary forces. People appear to recognize that their predictions are biased and that these predictions deviate from an ideal standard. The surprising conclusion, is that people believe this deviation is due to predictions not being optimistic enough."

Communication of risk

J. Raling "Richter-type scale of risk
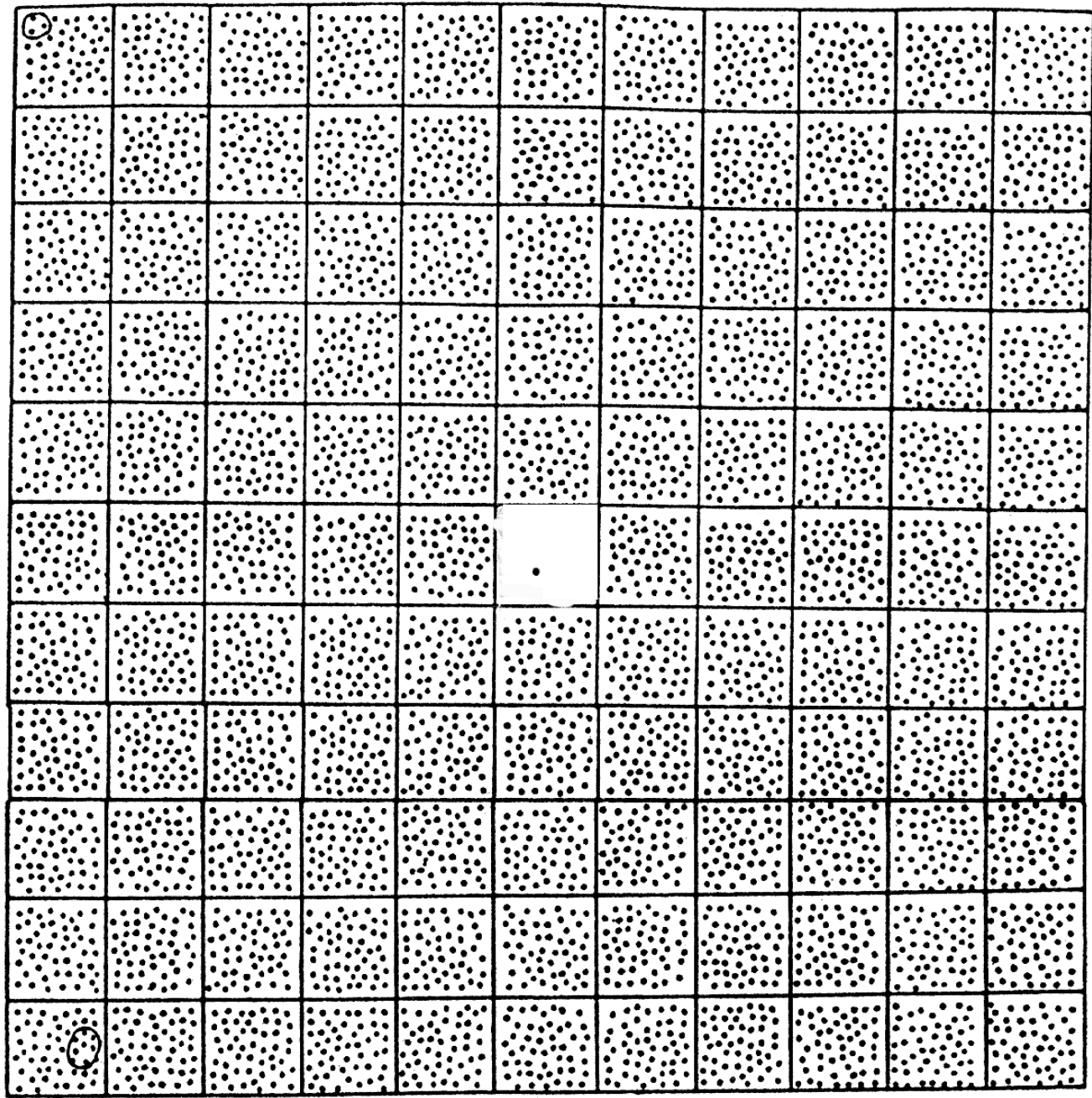
Example of how to display risk clinically

Number needed to treat = 20

Control event rate = 14%

Pain on days 2-7 in acute otitis media

Free from harm

Harmed by Rx

Saved by Rx

Not saved by Rx