ANNEX A: INTERACTIVE EXPERIMENT

Perception and communication of risks and uncertainty

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The first conference day included a 'Playful Element' as an intermezzo. During this conference component, the delegates were presented with several experiments relating to perception of and communication about risks and uncertainty. The experiments consisted of multiple-choice questions, whereby the delegates could indicate their choice by means of a voting machine. During the introductory presentation by Arthur Petersen (MNP) this same system was used to assess the delegates' attitude towards uncertainty (see Attitude Assessment) and to familiarise them with the system. The experiments are outlined below. The question posed to the delegates, the answer options, the results and background are set out for each experiment.

Attitude assessment

Question

The delegates are asked to choose from four propositions relating to uncertainty. A distinction is made between scientists and policymakers in this respect:

1. Uncertainty is unwelcome and should be avoided. The challenge for science is to eliminate uncertainty by means of more and better independent research.
2. Uncertainty is unwelcome but unavoidable. The challenge for science is to quantify uncertainty and to separate facts and values as effectively as possible.
3. Uncertainty offers chances and opportunities. Uncertainty puts the role of science in perspective. Science is challenged to contribute to a less technocratic, more democratic public debate.
4. The division between science and politics is artificial and untenable. Science is challenged to be an influential player in the public arena.

Answer options

Policymakers:

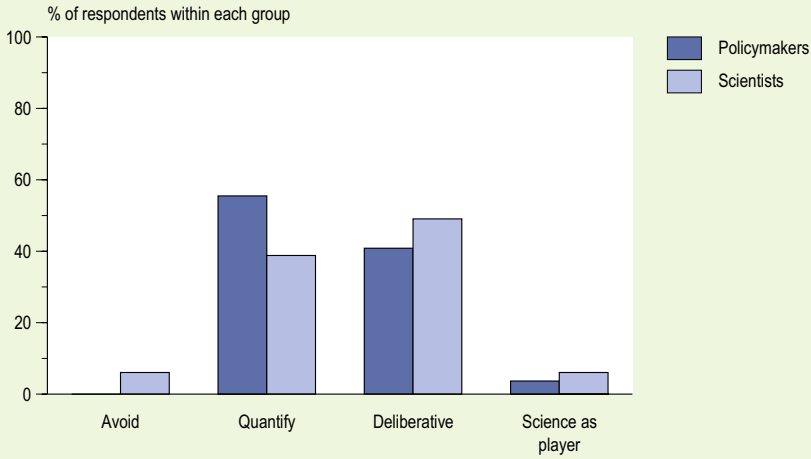
1. Avoid uncertainty.
2. Quantify uncertainty.
3. Uncertainty offers chances.
4. Science as a player.

Researchers:

5. Avoid uncertainty.
6. Quantify uncertainty.
7. Uncertainty offers chances.
8. Science as a player.

Results

Attitude towards uncertainty



Background

Recent studies into the science-policy interface focused on the views of policymakers and scientists with regard to uncertainty and the challenge for science therein. Views were measured on a four-point scale ranging from 'positivism' (science is objective and can provide 'the' answer) to 'constructivism' (science is part of society and therefore not objective, 'the' answer cannot be provided). The majority of the participants in the studies gave preference to 'quantification', a minority to 'science as a player'. The conference delegates appear to be more or less equally distributed over both middle answers. This is probably no surprise given the topic of the conference. The policymakers opted for 'quantification' slightly more often and for 'uncertainty offers chances' less often than the researchers.

Literature:

Van der Sluijs, J.P. (2005) Uncertainty as a monster in the science-policy interface: four coping strategies. Water Science & Technology, 52, pp. 87 – 92.

Wardekker, J.A., Van der Sluijs, J.P. (2006) *Evaluatie van Onzekerheidscommunicatie in de Milieubalans 2005*. Copernicus Institute for Sustainable Development and Innovation, Utrecht University.

Wardekker, et al. (2008). Uncertainty communication in environmental assessments: Views from the Dutch science-policy interface. *Environmental Science & Policy*.

Experiment 1: Opinion of one's own driving skills

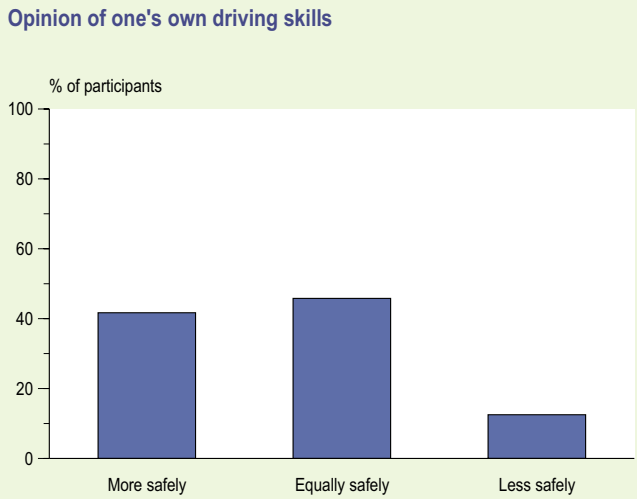
Question

How safely do you drive compared to the average car user?

Answer options

1. More safely.
2. Equally safely.
3. More unsafely.

Results



Background

During the early nineteen eighties, studies were conducted in Sweden and the USA into how car users assessed their own driving skills. The results showed a clear tendency by people to consider themselves better than average (USA: 78% safer, Sweden: 60% safer). In this case, the conference participants scored lower. The original data from Sweden and the USA may imply overconfidence, assuming that the group studied is characteristic of all car users. Gigerenzer (2002) stated, however, that the answers given need not necessarily indicate an irrational form of overconfidence. After all, it could also involve a asymetric distribution in the number of accidents, whereby a small group is responsible for the majority of accidents. In that case, more than 50% of the people can claim to drive more safely than 'average'.

Literature:

Gigerenzer, G. (2002) Calculated Risks: How to know when numbers deceive you. New York: Simon & Schuster.
Slovic, P., Fischhoff, B., Lichtenstein, S. (1981) Perceived Risk: Psychological factors and social implications. Proceedings of the Royal Society of London, Series A, Mathematical and Physical Sciences, 137, pp. 17 – 34.
Svenson, O. (1981) Are we all less risky and more skillful than our fellow drivers? Acta Psychologica, 47, pp.143 – 148.
Svenson, O., Fischhoff, B., MacGregor, D. (1985) Perceived Driving Safety and Seatbelt Usage. Accident Analysis & Prevention, 17 (2), pp. 119 – 133.

Experiment 2: The effect of framing

Question

For this question the audience was divided into 'left' and 'right' and each group was given a different question in an envelope.

Left group:
Suppose that the US is preparing for an outbreak of an unconventional type of Asian Influenza, which is expected to cost 600 human lives. Two control programmes are available, whereby:
- programme A will result in 200 lives being saved.
- the result of programme B is more uncertain: there is a one-in-three chance that 600 lives will be saved, and a two-in-three chance that none will be saved.

Which programme would you choose, A or B?

Right group:
Suppose that the US is preparing for an outbreak of an unconventional type of Asian Influenza, which is expected to cost 600 human lives. Two control programmes are available, whereby:
- programme C will result in 400 lives being lost.
- the result of programme D is more uncertain: there is a one-in-three chance that no lives will be lost, and a two-in-three chance that 600 will be lost.

Which programme would you choose, C or D?

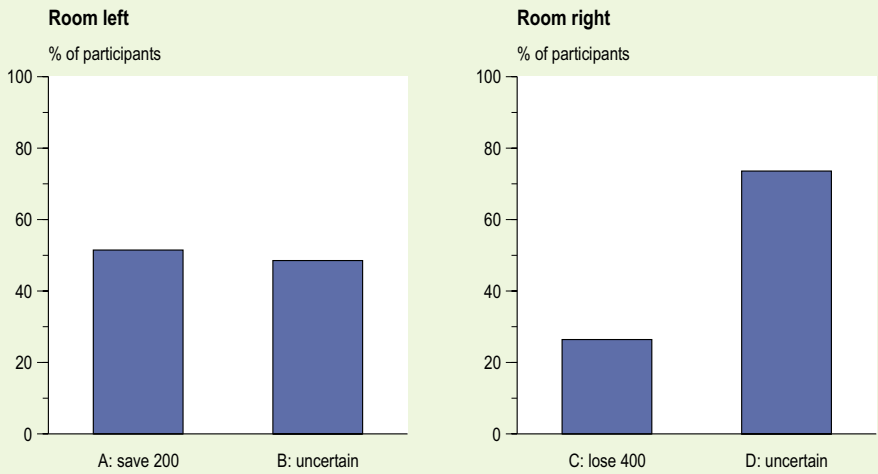
Answer options

Left group:
Programme A: save 200 lives.
Programme B: an uncertain result.

Right group:
Programme C: lose 400 lives.
Programme D: an uncertain result.

Results

Framing effect



Background

The above experiment is the well-known 'Asian disease experiment' by Kahneman and Tversky (1979). In the first case (left group), 72% of the tested people opted for programme A. In the second case (right group) 78% opted for programme D. This while programmes A and C are the same and so are programmes B and D. The only difference is the wording. A and B (left) involve 'saving', while C and D (right) involve 'losing'. During the conference a majority also opted for A rather than B, and for D rather than C. Apparently the difference between messages that are 'framed' positively or negatively matters. This situation often occurs in the practice of medicine. A positively framed message (chance of surviving) is more effective than a negatively framed one (chance of dying) when convincing someone to undergo a risky operation. In this respect framing in terms of gain (staying healthy) or loss (of health, years of one's life, relatives) is similar. Loss framing is more effective when convincing people to undergo a certain screening test. Hammond et al. (1999) gives several tips to avoid/reduce a distorted effect as a result of framing.

Literature:

Hammond, J.S., Keeney R.L., Raiffa, H. (1999) Smart Choices: a Practical Guide to Making Better Life Decisions. Cambridge, Mass.: Harvard Business School Press.
Kahneman, Daniel, Tversky, Amos (1979) Prospect Theory: An Analysis of Decision under Risk, Econometrica, XVLII, pp. 263 – 291.
Kahneman, D., & Tversky, A. (1984) Choices, values and frames. American Psychologist, 39, pp. 341 – 350. (Reprinted as chapter 1 in Kahneman, D., Tversky, A. red. (2000) Choices, Values and Frames. New York: Cambridge University Press and the Russell Sage Foundation).

Experiment 3: The effect of 'impact' on the communication of probabilities

Question

This experiment was subdivided into part 'A' (sender's perspective, great impact) and part 'B' (receiver's perspective, little impact).

Experiment 3A:
Suppose, you are a weather forecaster with a regional television channel. The meteorological institute informed you that there is a chance of heavy rain. This will have all kinds of consequences such as raised water levels in ditches and rivers, sewers that can no longer process the water and, possibly, flooding of low-lying areas (e.g. polders).

- You are a regional weather forecaster in a *low-lying polder area.*

The meteorological institute forecasts a 20% probability of heavy rain and you consider this a good estimate. Which of the following terms would you use to describe the probability of heavy rain to the viewers?

Experiment 3B:
Suppose, you are watching the regional news on the television. The weather forecaster forecasts heavy rain. This will have all kinds of consequences such as raised water levels in ditches and rivers, sewers that can no longer process the water and, possibly, flooding of low-lying areas (e.g. polders).

- You are a farmer in a *higher agricultural area.*

The regional weather forecaster, whom you trust, says that it is unlikely that there will be heavy rain. Based on this forecast, how likely do you think it is that there will be heavy rain?

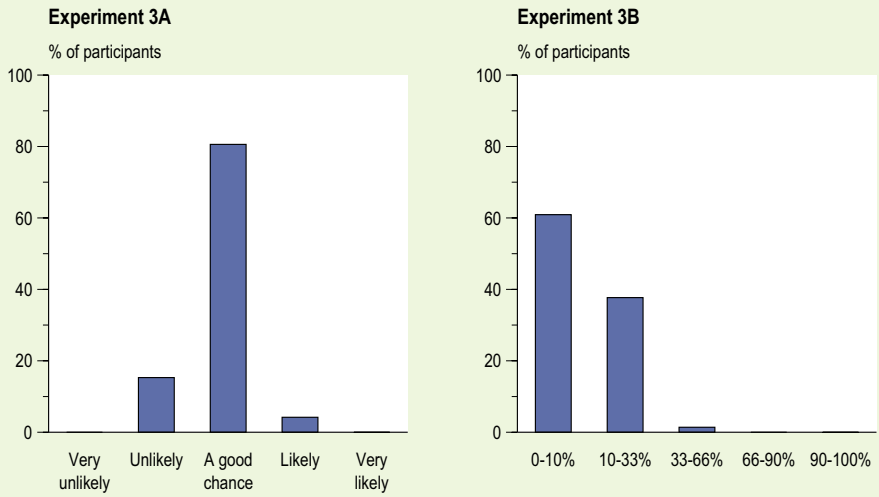
Answer options

Experiment 3A:
1. Very likely.
2. Likely.
3. A good chance.
4. Unlikely.
5. Very unlikely.

Experiment 3B:
1. 0% – 10%
2. 10% – 33%
3. 33% – 66%
4. 66% – 90%
5. 90% – 100%

Results

Impact effect for verbal and numerical communication on probabilities



Background

Literature (Patt and Schrag, 2003) shows that, when choosing an uncertainty term, people intuitively keep the impact in mind. Matters that have a great impact are communicated in more certain terms than those that have little impact. When interpreting, the receiver of such a message intuitively takes into account the sender's inclination. In matters that have a great impact, the normally 'too certain' term is translated into in a reduced likelihood. In matters that have little impact, the normally 'too uncertain' term is translated into an increased likelihood. This may present problems when standardised terminology is used (e.g. IPCC terminology). In choosing a term, the sender no longer takes the impact into account, but the receiver still does. The conference experiment presented a situation with 20% probability and a corresponding standardized probability term 'unlikely'. Experiment 3A focuses on 'sender, great impact', 3B on 'receiver, little impact'. Questions relating to 'sender, little impact' and 'receiver, great impact' were left out and experiments 3A and 3B were carried out in a series (not independently of each other), because of the time involved. Nonetheless, a difference appears to be noticeable: with regard to a great impact (3A) the centre term is chosen, while the lower ranges of probability are chosen with regard to little impact (3B). The outcome of 3B appears in conflict with Patt and Schrag; here the normally 'too uncertain' term is translated into a reduced instead of an increased likelihood. Without the questions that were left out, however, it is difficult to say whether the outcome of this experiment can be explained by the difference in impact or, for example, the difference in interpretation of the terms and ranges of probability.

Literature:

Patt, A.G., Schrag, D.P. (2003) Using specific language to describe risk and probability. Climatic Change, 61, pp. 17 – 30.

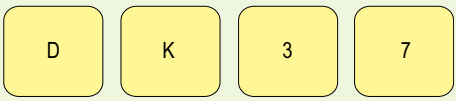
Experiment 4: Confirmation bias (tendency to look for affirmative information)

Question

This experiment consists of two equivalent problems of choice in different situations.

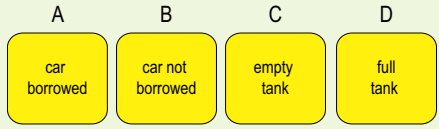
Experiment 4A:
Someone has a pack of cards and says that the following rule applies to these cards: *'A card with a letter D on one side also has a figure 3 on the other'.*

Next, four cards are put in front of you, whereby you may turn two of them to check whether this rule has been complied with.



Which two cards do you choose to turn?

Experiment 4B:
The children of the Janssen family are allowed to borrow their parents' car in the weekend provided that they return it with a full tank.
You are interested in finding out whether they keep to this agreement. Each card represents one of the four children, whereby one side shows whether the child borrowed the car on a particular day and the other side whether the tank had been filled on returning the car.



Which two cards do you choose to turn?

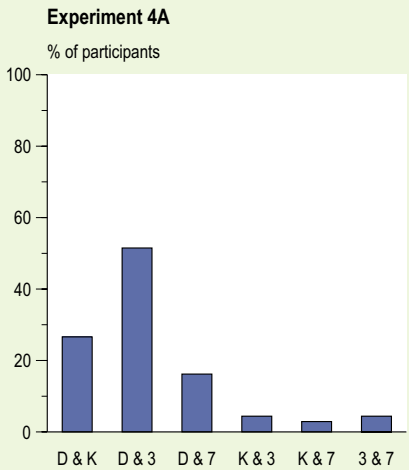
Answer options

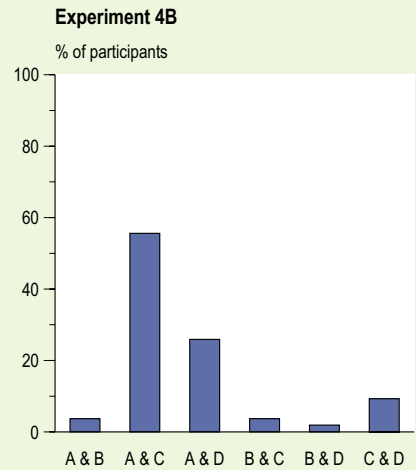
Experiment 4A:
D and K
D and 3
D and 7
K and 3
K and 7
3 and 7

Experiment 4B:
A and B
A and C
A and D
B and C
B and D
C and D

Results

Confirmation bias





Background

With the abstract problem in experiment 4A, people tend to turn cards D and 3, in search for an affirmative answer. Strong first impressions structure the way in which the next information is interpreted. The conference delegates also picked D and 3. Logically speaking, D and 7 would have been the right choice: D to verify, and 7 to falsify. In the concrete situation of experiment 4B, people's own experience appears to be leading: people are not purely looking for confirmation that these are good children. They usually choose correctly 'car borrowed (A)' and 'empty tank (C)'. The conference delegates did exactly the same. The confirmation bias (resulting in selecting A and D) appears to be playing a less important role here.

Literature:
Slovic, P., Fischhoff, B., Lichtenstein, S. (1984) Behavioral Decision Theory Perspectives on Risk and Safety. Acta psychologica, 56, pp. 183 –203.

Experiment 5: Anchoring (relying too much on initial thoughts/impressions/ information)

Question

For this question the audience was divided into 'left' and 'right' and each group was given a different question in an envelope. The delegates were asked first to answer questions A and B for themselves. Next they were asked to make their choice using the voting system.

Left group:
(a). Is Turkey's population higher than 35 million?
Answer: [Yes/No].
(b). How many people do you think live in Turkey?
Answer: ... million.

Right group:
(a). Is Turkey's population higher than 100 million?
Answer: [Yes/No].
(b). How many people do you think live in Turkey?
Answer: ... million.

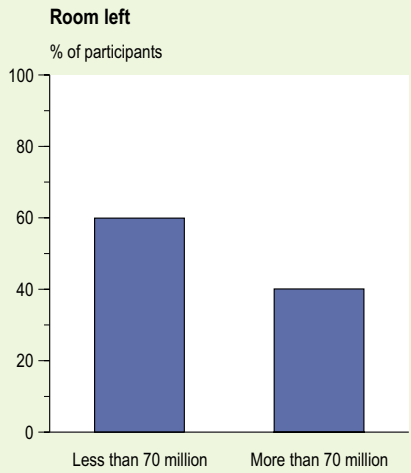
Answer options

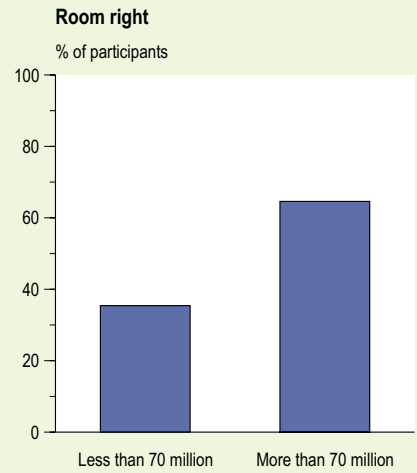
Left group:
Turkey's population < 70 million
Turkey's population > 70 million

Right group:
Turkey's population < 70 million
Turkey's population > 70 million

Results

Anchoring





Background

When answering questions, people tend to base their answers on previous thoughts, impressions or information (anchoring). In this case, first the number of 35 million (left) or 100 million (right) was mentioned. People's own, subsequent estimate can be 'anchored' to this number. Conference delegates who were initially told 35 million, later opted more often for 'less than 70 million' than those who were initially told 100 million. According to the CIA World Factbook Turkey actually has a population of approx.70 million.

Literature:

CIA (2006). The World Factbook. On the internet: https://www.cia.gov/cia/publications/factbook/
Hammond, J.S., Keeney R.L., Raiffa, H. (1999) Smart Choices: a Practical Guide to Making Better Life Decisions. Cambridge, Mass.: Harvard Business School Press.

Experiment 6: Prospect theory: valuation of profit and loss

Question

For this question the audience was divided into 'left' and 'right' and each group was given a different question in an envelope.

Left group:
Suppose you are given 300 euros. You now have the option of receiving another 100 euros or tossing a coin. If you win the toss, you will receive another 200 euros; if not, the amount stays at 300 euros.

What option do you choose (1 or 2)?

Right group:
Suppose you are given 500 euros. You now have the option of handing in 100 euros or tossing a coin. If you lose the toss, you need to pay back 200 euros; if you win you do not pay back anything.

What option do you choose (3 or 4)?

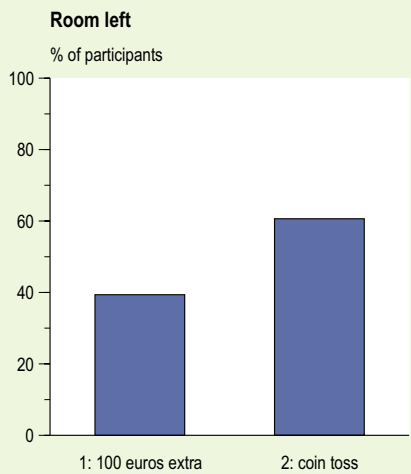
Answer options

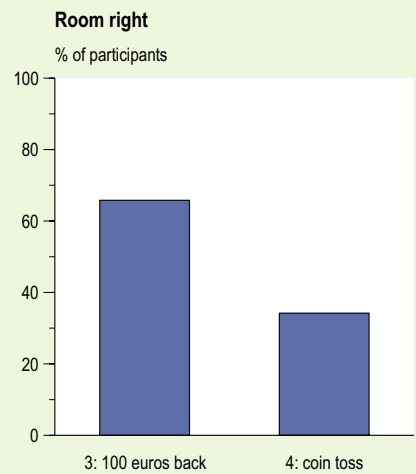
Left group:
Receive another 100 euros.
Toss a coin.

Right group:
Hand back 100 euros.
Toss a coin.

Results

Valuation of profit and loss





Background

The Prospect Theory asserts that risks relating to profit and loss are valued differently. In the case of profit (left group) people appear to prefer certainty (risk-avoiding behaviour). A 50% chance of getting another 200 euros is 'weighted lighter' and considered more unattractive than the certainty of winning 100 euros. With regard to loss (right group), people prefer to gamble (risk-seeking behaviour). The majority of the conference delegates, however, appear to have other preferences.

Literature:
Kahneman, Daniel, Tversky, Amos (1979) Prospect Theory: An Analysis of Decision under Risk, Econometrica, XVLII, pp. 263 – 291.

Experiment 7: Communicating about probabilities

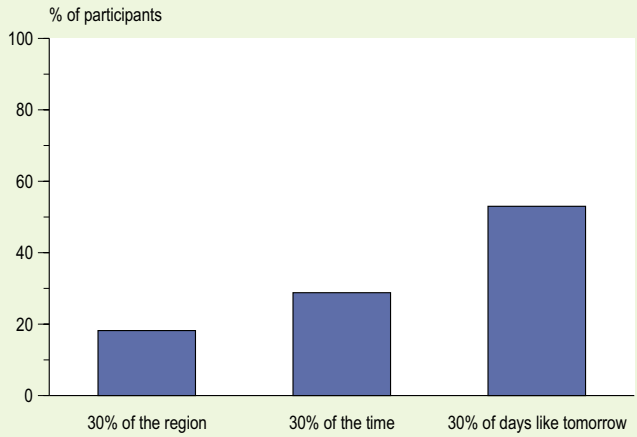
Question

In a news bulletin you read: A 30% chance of rain tomorrow.
What do you think this statement means?

Answer options

Tomorrow it will rain in 30% of the area.
Tomorrow it will rain for 30% of the time.
It will rain on 30% of days that are like tomorrow.

Results



Background

A recent study among pedestrians in four large cities in Europe and the USA, showed that the majority opts for '30% of the time'. The interpretation as used by weather forecasters 'on 30% of days like tomorrow' is chosen by the fewest pedestrians. The majority of the conference delegates choose the right answer. The lesson learnt from this is that, in order to avoid misunderstandings in communication, experts should explicitly refer to the right context/meaning/class of reference that they are applying. The above example could have been better communicated in terms of frequency rather than in terms of probability.

In another example, experienced forensic experts were presented with a report on the risk of a patient committing another violent crime after a treatment. When it was stated that 'an estimated 10 in every 100 patients like Mr Jones will commit a violent crime after a six-month treatment', the patient was considered more dangerous than when it was stated that 'there is a 10% chance that patients like Mr Jones will commit a violent crime after a six-month treatment'.

Literature:

Gigerenzer, G., Hertwig, R., Van den Broek, E., Fasolo, B., Katsikopoulos, K.V. (2005) 'A 30% chance of rain tomorrow': How does the public understand probabilistic weather forecasts? Risk Analysis, 25, pp. 623 – 629.
Slovic, P., Monahan, J., MacGregor, D.M. (2000) Violence risk assessment and risk communication: The effects of using actual cases, providing instructions, and employing probability vs. frequency formats. Law and Human Behavior, 24 (3), pp. 271 – 296.