# The effective communication of risk:

# Insights from cognitive science

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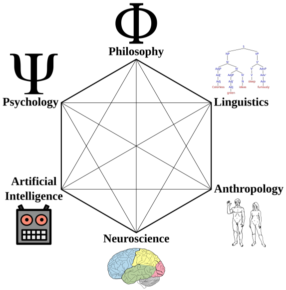
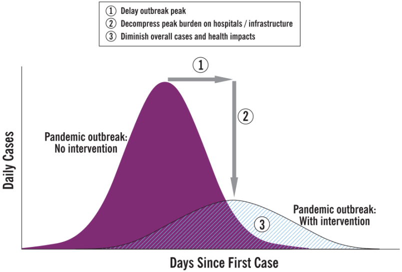
# Cognitive science




- Multidisciplinary scientific study of the mind
- Whole spectrum of phenomena – from neuroscience to social cognition
- **Key assumption:** Information processing underlies intelligent behaviour

# Effective risk communication saves lives, reduces harm

- **Fukushima, 2011:** Delay and ambiguity in risk communication led to public confusion, panic, and lack of trust
- **Covid-19:** US CDC's "Flatten the curve" message and infographic conveyed complex information effectively



# Aims of this talk

- Understanding human factors crucial when designing effective communication of risk
- **Three examples:**
  - How people interpret different representations of risk
    - Probabilities v natural frequencies
    - Relative v absolute risk
  - How people's attitude to risk depends on their perception of the situation
- **Level:** General audience — no assumption of familiarity with ideas

# The danger of talking about probabilities

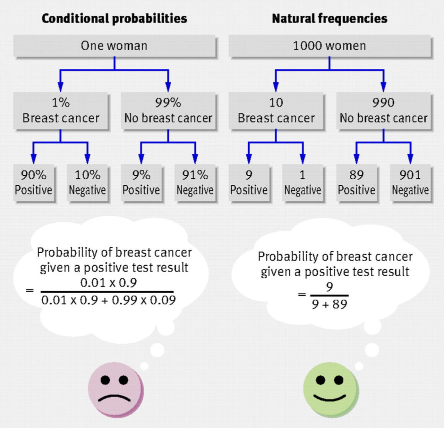
## The problem with probabilities

- People misinterpret risks presented as percentages or probabilities (Gigerenzer et al., 2005)
- People prescribed prozac interpreted “30–50% chance of developing a sexual problem” as that something would go awry in 30–50% of their sexual encounters
- People interpret “a 30% chance of rain tomorrow”
  - It’s going to rain for 30% of the time
  - It’s going to rain in 30% of the area
  - **Correct interpretation:** when weather conditions are like today, in 3 out of 10 cases there will be (at least a trace of) rain tomorrow

Gigerenzer et al. (2007) tested 160 gynaecologists

- p(woman has breast cancer) = 1%
- Woman **has** breast cancer, p(positive test) = 90%
- Woman **does not** have breast cancer, p(positive test) = 9%
- **What is the probability that a woman who tested positive has cancer?**
    - Almost 50% of gynaecologists said 90% (.9)
    - Only 21% correctly said 10% (.1)

# Why the confusion?




- Left: Conditional probabilities and Bayes' rule
- Right: Natural frequencies requires easier calculation

# Presenting risk information using natural frequencies

## Early detection of breast cancer by mammography screening

HARDING CENTER FOR RISK LITERACY

Numbers for women aged 50 years or older* who either did or did not participate in mammography screening for approximately 11 years.

| | 1,000 women without screening | 1,000 women with screening |
|---|---|---|
| **Benefits** | | |
| How many women died from breast cancer? | 5 | 4 |
| How many women died from all types of cancer? | 22 | 22 |
| **Harms** | | |
| How many women experienced false alarms and had additional testing or tissue removed (biopsy)? | – | 100 |
| How many women with non-progressive breast cancer had unnecessary partial or complete removal of a breast? | – | 5 |

*Where no data for women above 50 years of age are available, numbers refer to women above 40 years of age.

**Short summary:** Mammography screening reduced the number of women who died from breast cancer by 1 in 1,000. However, it had no effect on the number of women who died of cancer overall. Among all women taking part in screening, some with non-progressive cancer were overdiagnosed and unnecessarily treated.

Source: Gøtzsche & Jørgensen. *Cochrane Database Syst Rev* 2013(6):CD001877.

Letztes Update: November 2017

www.harding-center.mpg.de/de/faktenboxen

- Take home message
  - When communicating risk, avoid using probabilities
  - Better to use natural frequencies instead

# The danger of talking about relative risk

# Relative and absolute risk

- ‘Careless pork costs lives’ (Riesch & Spiegelhalter, 2011)
- **Absolute risk:** The odds of something happening
  - e.g., AR of developing bowel cancer for average UK diet including meat = 6%
  - i.e., 6 in every 100 people with this diet develop bowel cancer during their lives
- **Relative risk:** Compares odds between two scenarios
  - e.g., 50g extra processed meat a day = 18% increase in bowel cancer
  - 18% increase sounds a lot!
  - But! An increase of 18% of 6% = 7% absolute risk
  - So the **absolute risk** increased by only 1 in 100

## The 1995 "pill scare"

- In 1995, UK Committee on Safety of Medicines warned that 3rd Gen contraceptive pill "doubled thrombosis risk"
- **Consequences**
  - Oral contraception use fell generally and from 40% to 27% of under 16s
  - 13,000 additional abortions following year
  - Additional cost to NHS (Furedi, 1999)
    - £21M additional maternity care
    - £46M million for abortion provision

# What were the absolute risks?

- Risk of thrombosis greater in pregnancy or abortion than with 3rd Gen pill
- Risk associated with 2nd Gen pill = 1 in every 7,000
- Risk associated with 3nd Gen pill = 2 in every 7,000
- So the **absolute risk** increased by only 1 in 7,000
- Take home message
  - When communicating risk, be aware how relative risk can mislead
  - Better to translate RR into differences in AR

# People’s attitude to risk depends on context

# The effect of problem framing on risk preference

- Individuals vary in terms of their attitude to risk
- Attitudes are not fixed but depend on how a situation is perceived
- People's risk preferences can be changed by reframing the problem

# A matter of life and death – scenario 1

- Imagine preparing for a deadly disease outbreak that is predicted to kill 600 people (Tversky & Kahneman, 1981)
- Two programmes proposed to combat the disease:
  - **A**, $p(1.0)$ 200 people will be saved
  - **B**, $p(.33)$ 600 people saved, $p(.66)$ nobody saved
- Which programme would you choose?

# A matter of life and death – scenario 1

- Two programmes proposed to combat the disease:
  - **A**, $p(1.0)$ 200 people will be saved 72%
  - **B**, $p(.33)$ 600 people saved, $p(.66)$ nobody saved 28%
- Framed as gain (“saved from death”), safe option preferred
- People are risk averse – certain gains better than gamble

# A matter of life and death – scenario 2

- Imagine preparing for a deadly disease outbreak that is predicted to kill 600 people (Tversky & Kahneman, 1981)
- Two programmes proposed to combat the disease:
  - **C**, $p(1.0)$ 400 people will die
  - **D**, $p(.33)$ nobody will die, $p(.66)$ 600 people will die
- Which programme would you choose?

# A matter of life and death – scenario 2

- Two programmes proposed to combat the disease:
  - **C**, $p(1.0)$ 400 people will die 22%
  - **D**, $p(.33)$ nobody will die, $p(.66)$ 600 people will die 78%
- Outcomes of scenarios same (A ≡ C, B ≡ D)
- Framed as loss (“condemned to die”), risky option preferred
- Take home message
  - Choices involving gains are often risk averse
  - Choices involving losses are often risk taking
  - The way you communicate situations can significantly affect behaviour

# Conclusions

- Cognitive science has uncovered many heuristics and cognitive biases that affect how people interpret information, including risk
- Other factors: emotion, prior knowledge (mental models), cultural differences, infographic design etc.
- Experts can't just assume their messages will be interpreted as intended
- For communication to be effective, it must be informed by our knowledge of how people process information

Furedi, A. (1999).*Social consequences. The public health implications of the 1995 "pill scare".* *Human Reproduction Update*, *5*(6), 621–626. doi: 10.1093/humupd/5.6.621.

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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*(3), 623–629. doi: 10.1111/j.1539-6924.2005.00608.x.

Riesch, H., & Spiegelhalter, D. J. (2011).*'Careless pork costs lives': Risk stories from science to press release to media.* *Health, Risk & Society*, *13*(1), 47–64. doi: 10.1080/13698575.2010.540645.

Tversky, A., & Kahneman, D. (1981).*The framing of decisions and the psychology of choice.* *Science*, *211*(4481), 453–458. doi: 10.1126/science.7455683.