Communicating risk and uncertainty to policy-makers and the public

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CCU 2015

Summary

- Risk and uncertainty
- Framing
- Anchoring
- The power of story
- “Uniform reporting of benefits and harms”
- Deeper uncertainty
- ‘Confidence’ in analyses

Government
Office for Science

INNOVATION: MANAGING RISK, NOT AVOIDING IT

Annual Report of the Government Chief Scientific Adviser 2014

Risk and uncertainty

- Impossible to get agreed definitions
- I will broadly use

Risk

- statements about the hazard
- (generally numerical)

[aka *uncertainty about the outcome*]

Uncertainty

– statements about the analysis of the risks (not numerical)

[aka *deeper uncertainty*]

Framing of numbers

Can we stop media picking on most extreme case
– *"could be as high as…"*

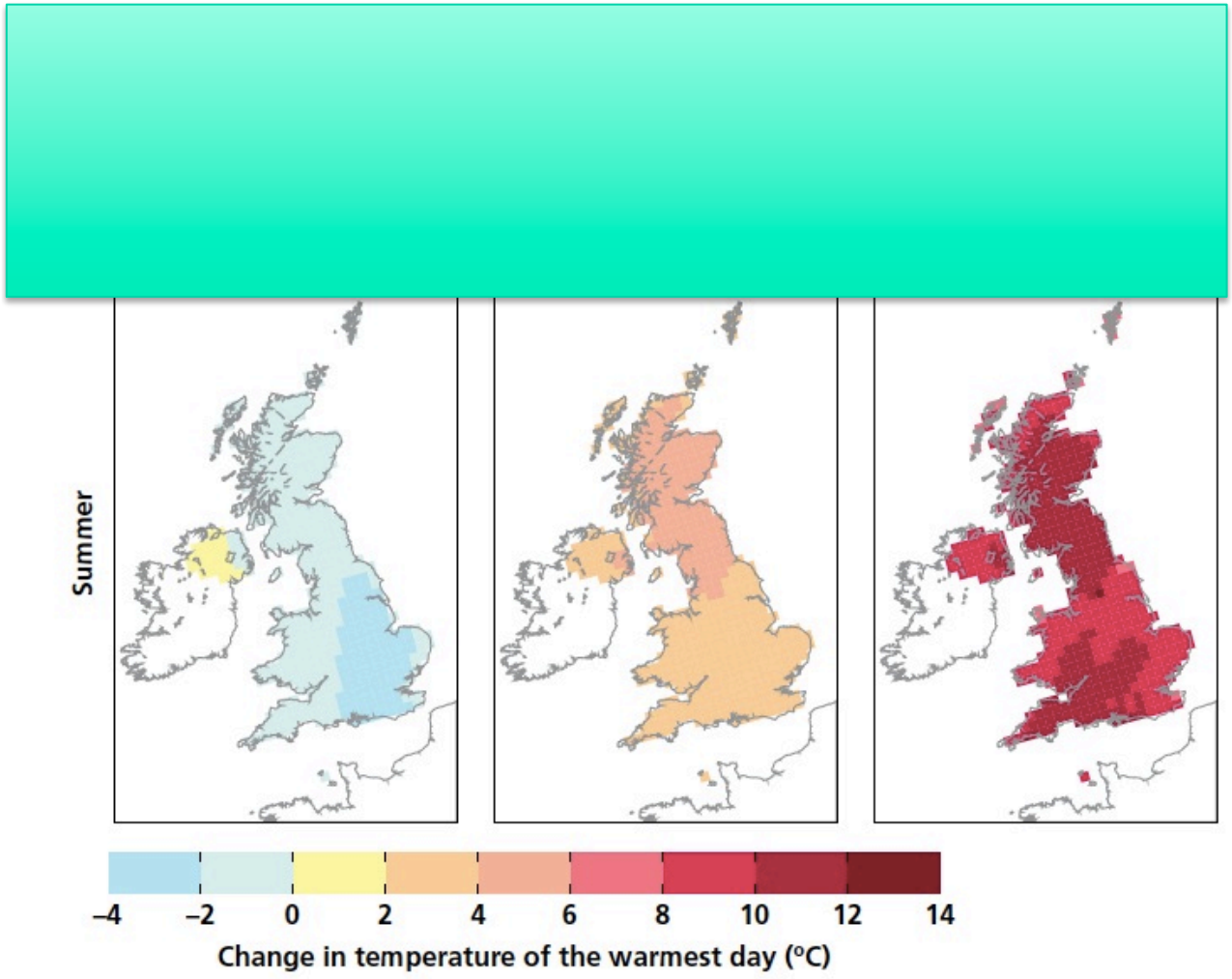


Figure 4.8: 10, 50 and 90% probability levels of changes to the temperature of the warmest day of the summer, by the 2080s, under the Medium emissions scenarios.

DEFRA framing

"very unlikely to be greater than"

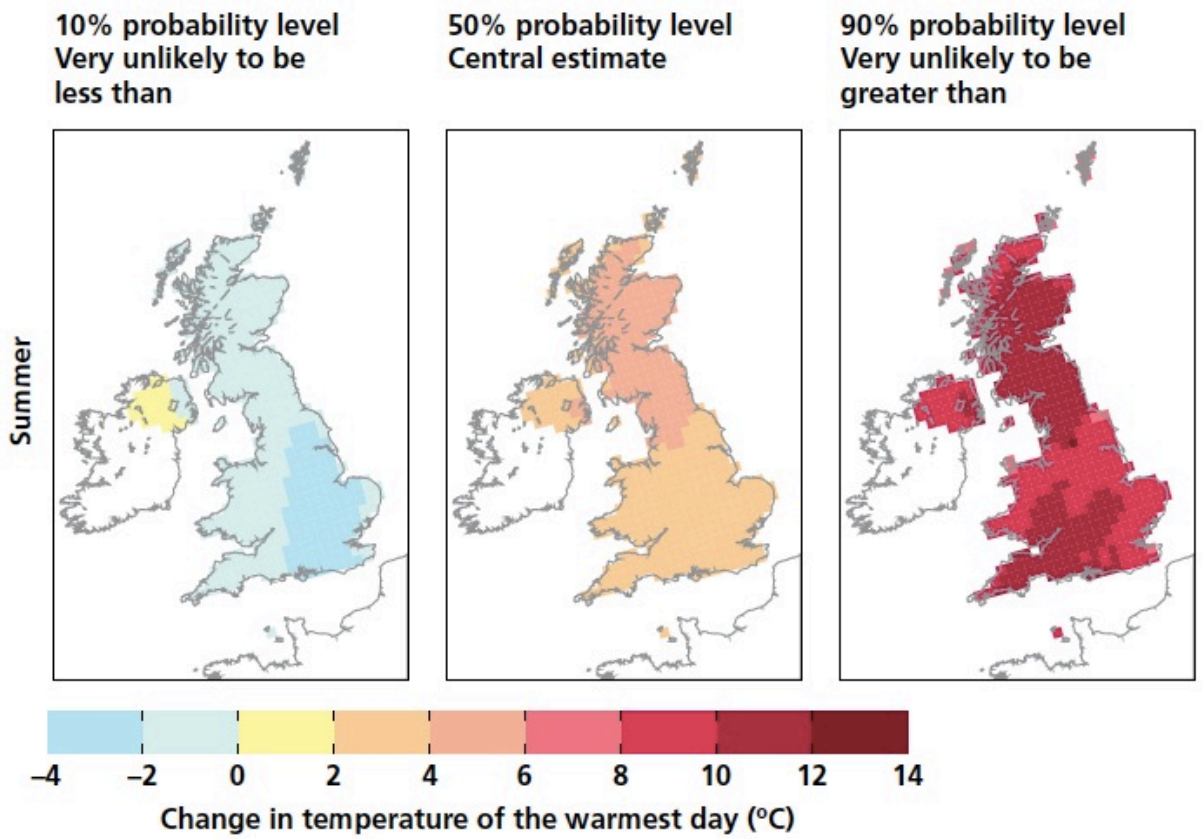
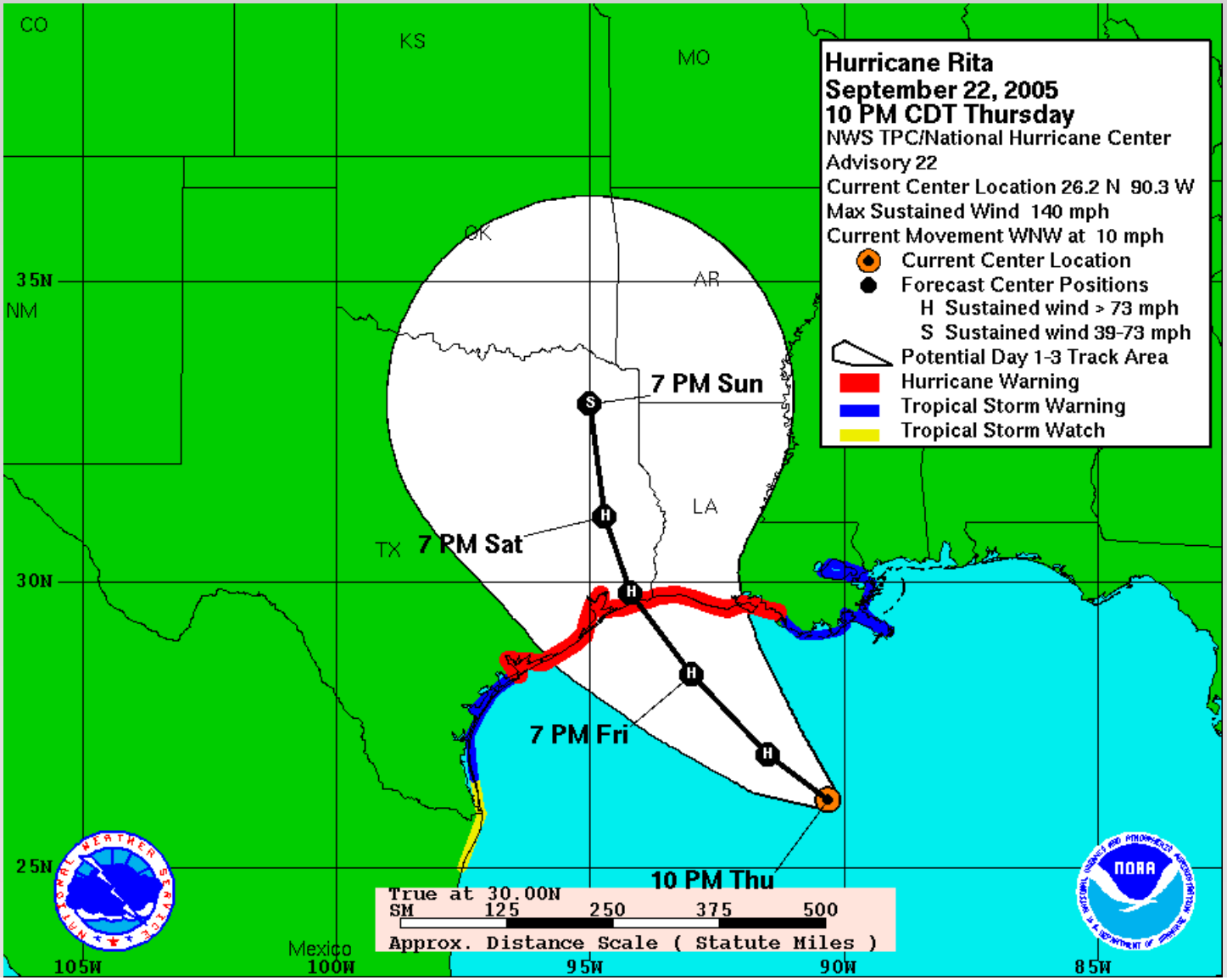


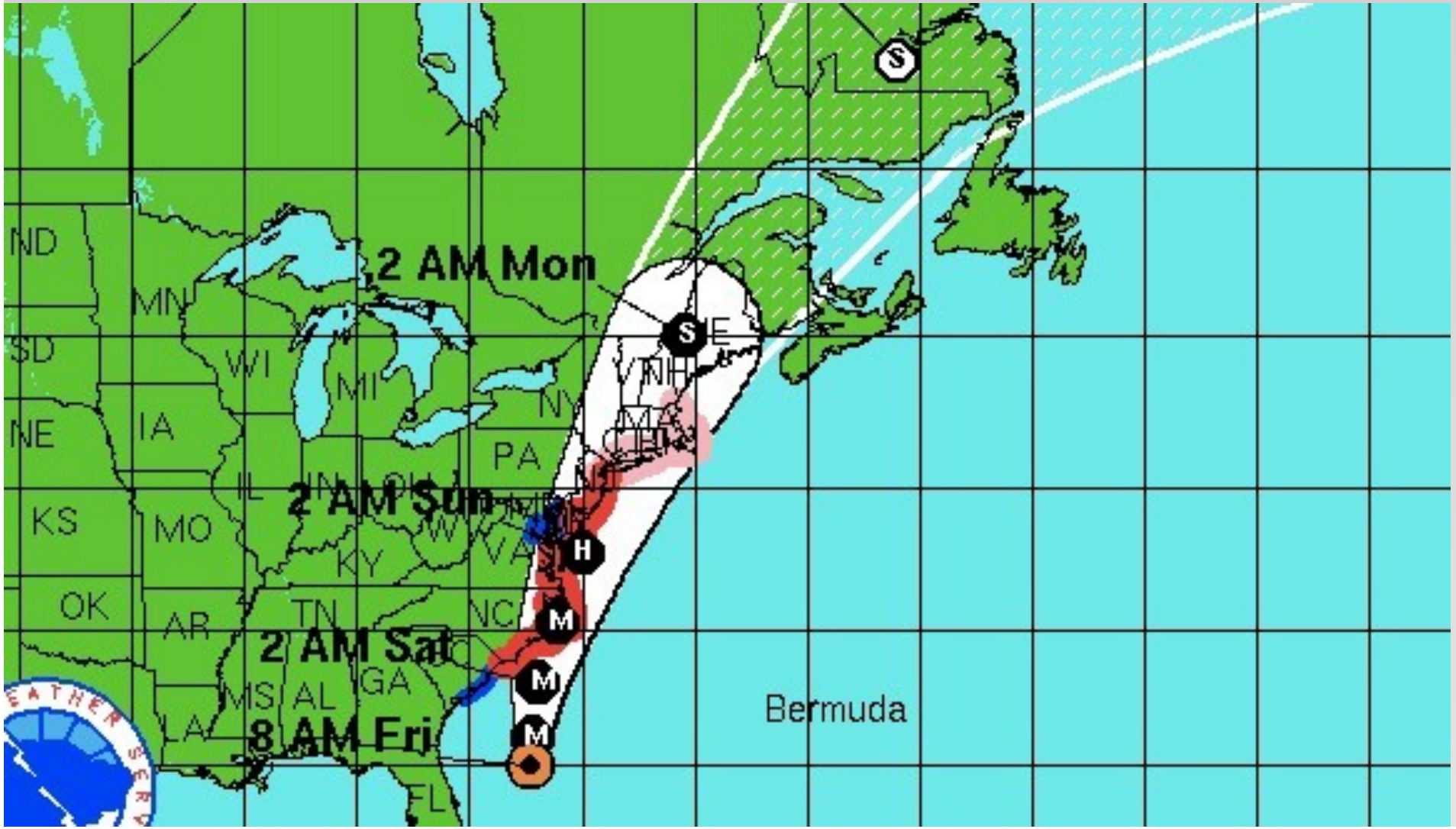
Figure 4.8: 10, 50 and 90% probability levels of changes to the temperature of the warmest day of the summer, by the 2080s, under the Medium emissions scenarios.

Anchoring

“Cone of Uncertainty” for hurricane warnings



2011: Hurricane Irene

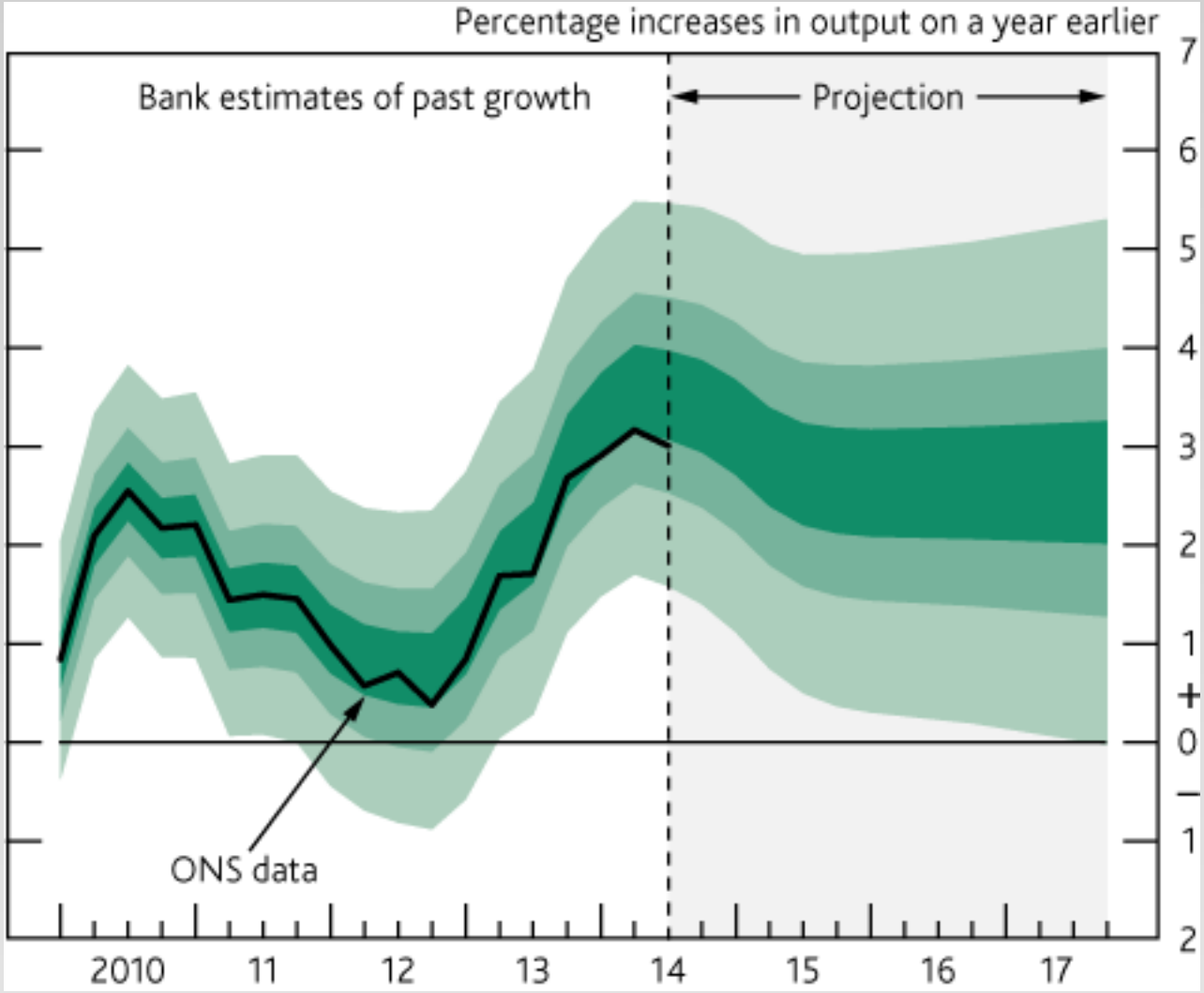


Metaphor of ‘possible futures’

2011: NBC News for Hurricane Irene

'Possible futures' metaphor

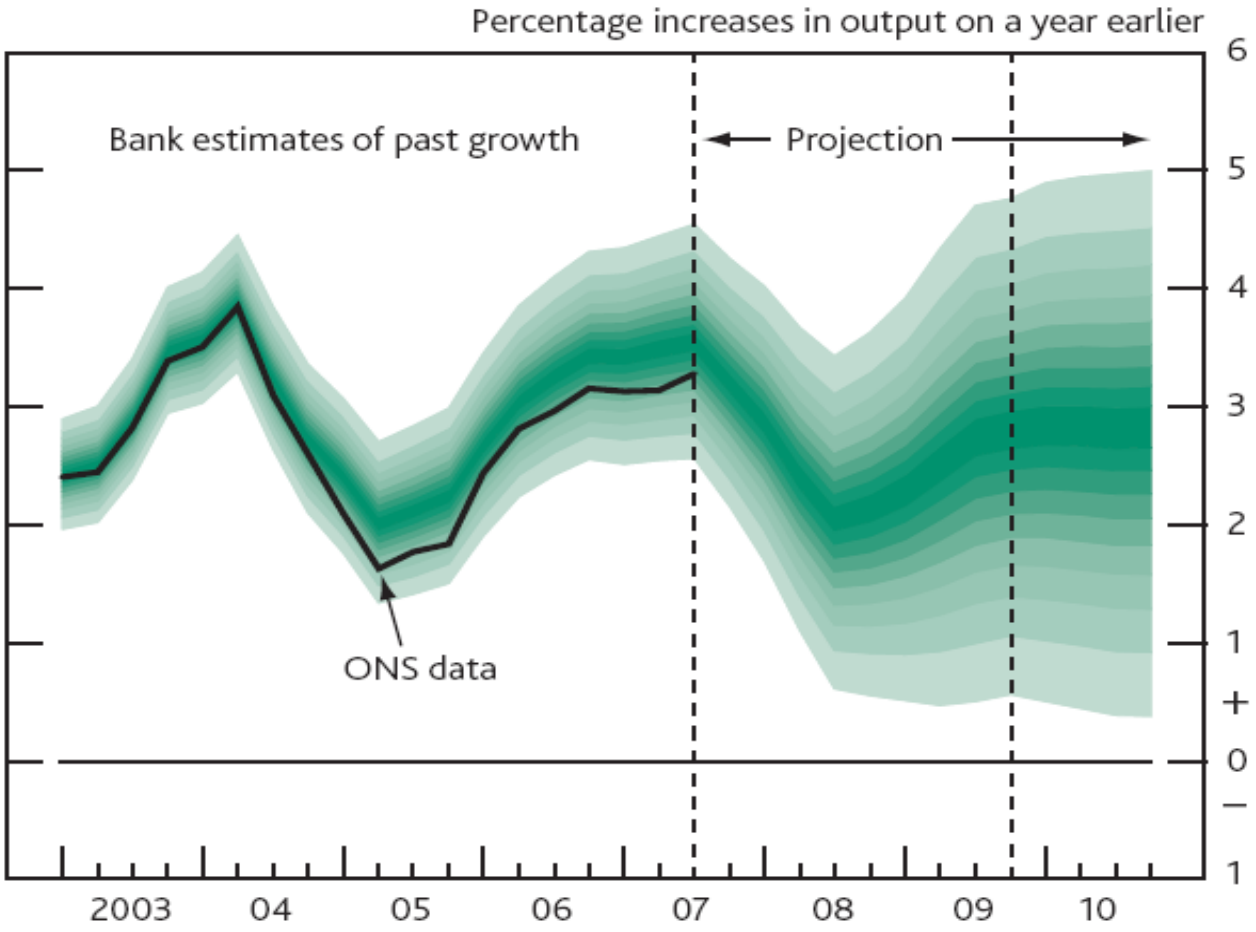
Bank of England Fan Charts



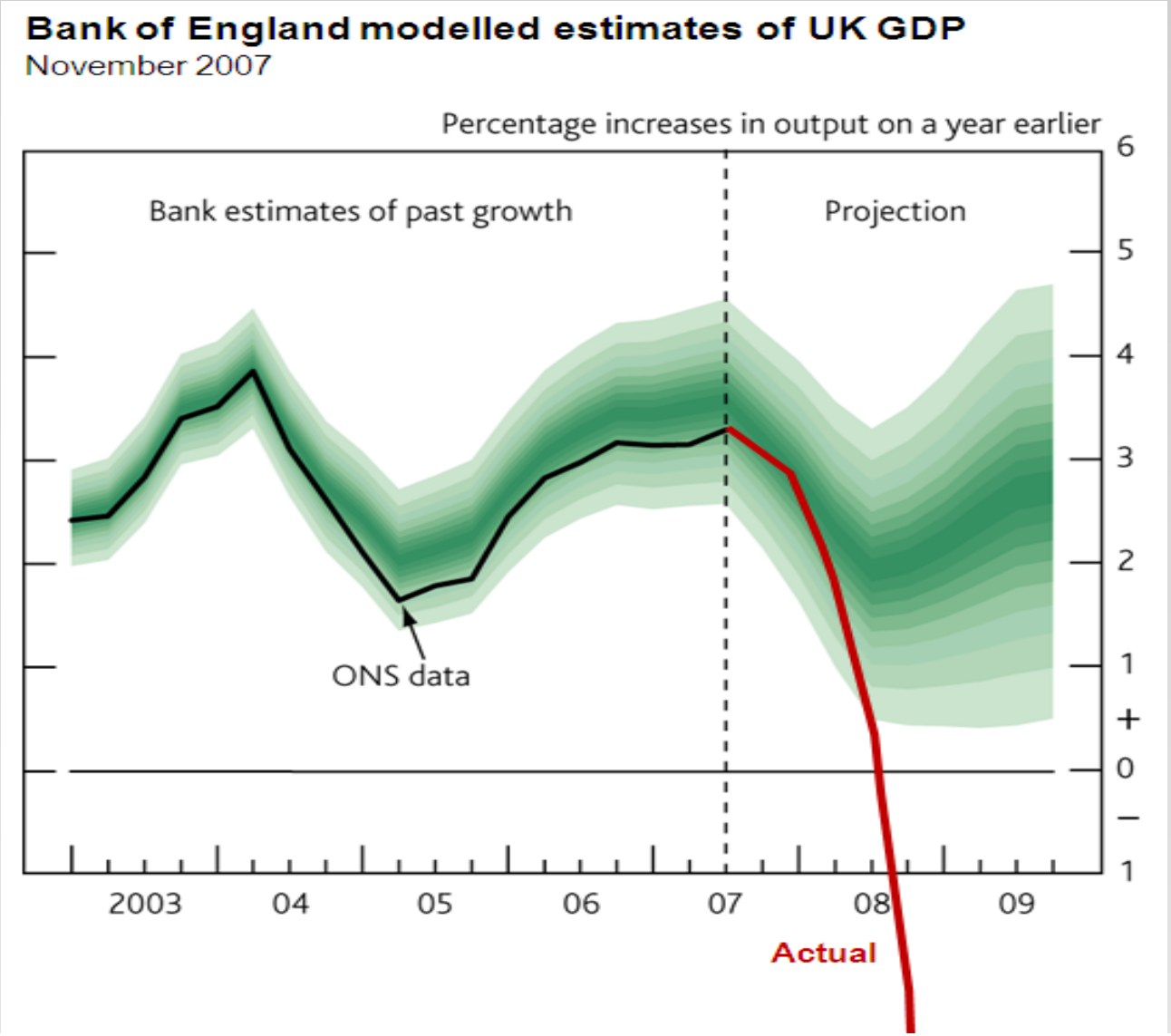
Bank of England Fan Charts

- *If economic circumstances identical to today's were to prevail on 100 occasions …*
- *Consequently, GDP growth is expected to lie somewhere within the entire fan on 90 out of 100 occasions*

Chart 5.1 GDP projection based on market interest rate expectations



Can compare with what happened

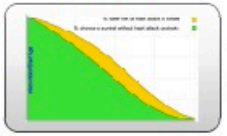


The power of metaphor / story

JBS3 Cardiovascular Risk Assessment

Profile | Heart Age | Healthy Years | Outlook





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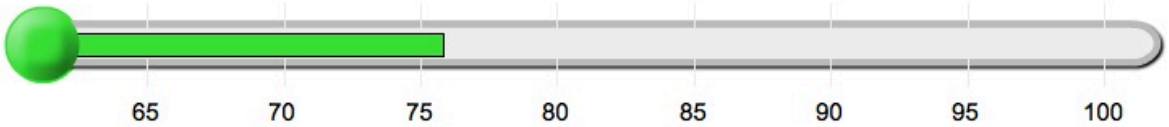
On average, expect to survive to age 75 without a heart attack or stroke



expected life without a heart attack or stroke

Your risk of a heart attack or stroke in the next 10 years is

17%

assuming you don't die of anything else

Interventions

Future smoking category

20+/day

Systolic Blood Pressure

134 → 134

Total Cholesterol

5.9 → 5.9

HDL Cholesterol

1.3 → 1.3

NonHDL Cholesterol: 4.6

BMI: 26.2

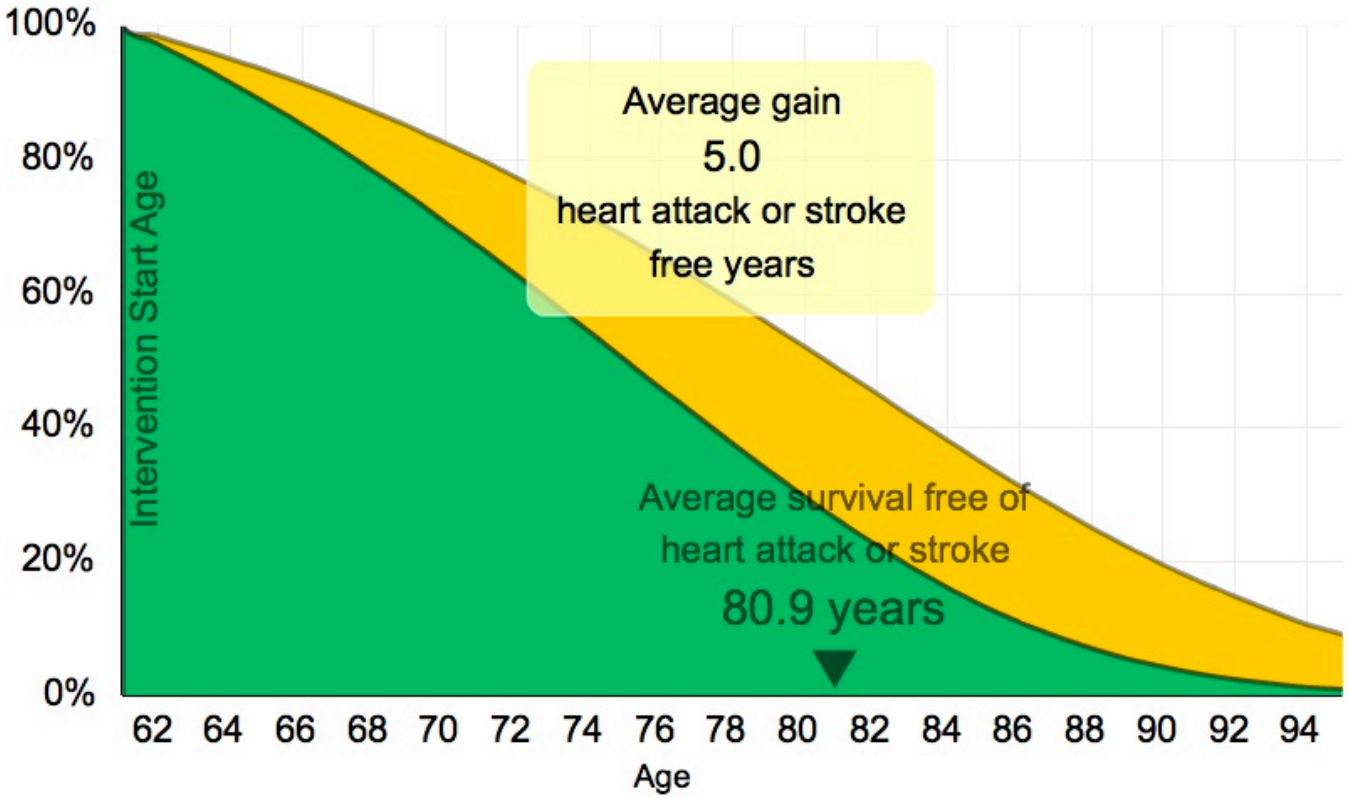
Reset

JBS3 Cardiovascular Risk Assessment

Profile | Heart Age | Healthy Years | Outlook

more

% Chance of survival free of Heart Attack or Stroke



Intervention start age 61

Interventions

Future smoking category: I quit

Systolic Blood Pressure: 134 → 134

Total Cholesterol: 5.9 → 5.9

HDL Cholesterol: 1.3 → 1.3

NonHDL Cholesterol: 4.6

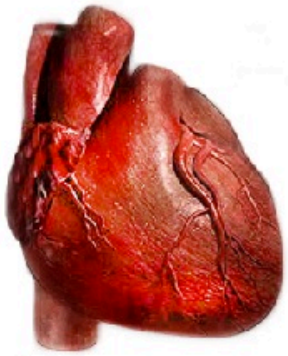
BMI: 26.2

Reset

JBS3 Cardiovascular Risk Assessment

Profile | Heart Age | Healthy Years | Outlook

more



Your heart age is about

74

compared to a person of the same age, gender and ethnicity with optimal risk factors

Interventions

Future smoking category

20+/day

Systolic Blood Pressure

134 → 134

Total Cholesterol

5.9 → 5.9

HDL Cholesterol

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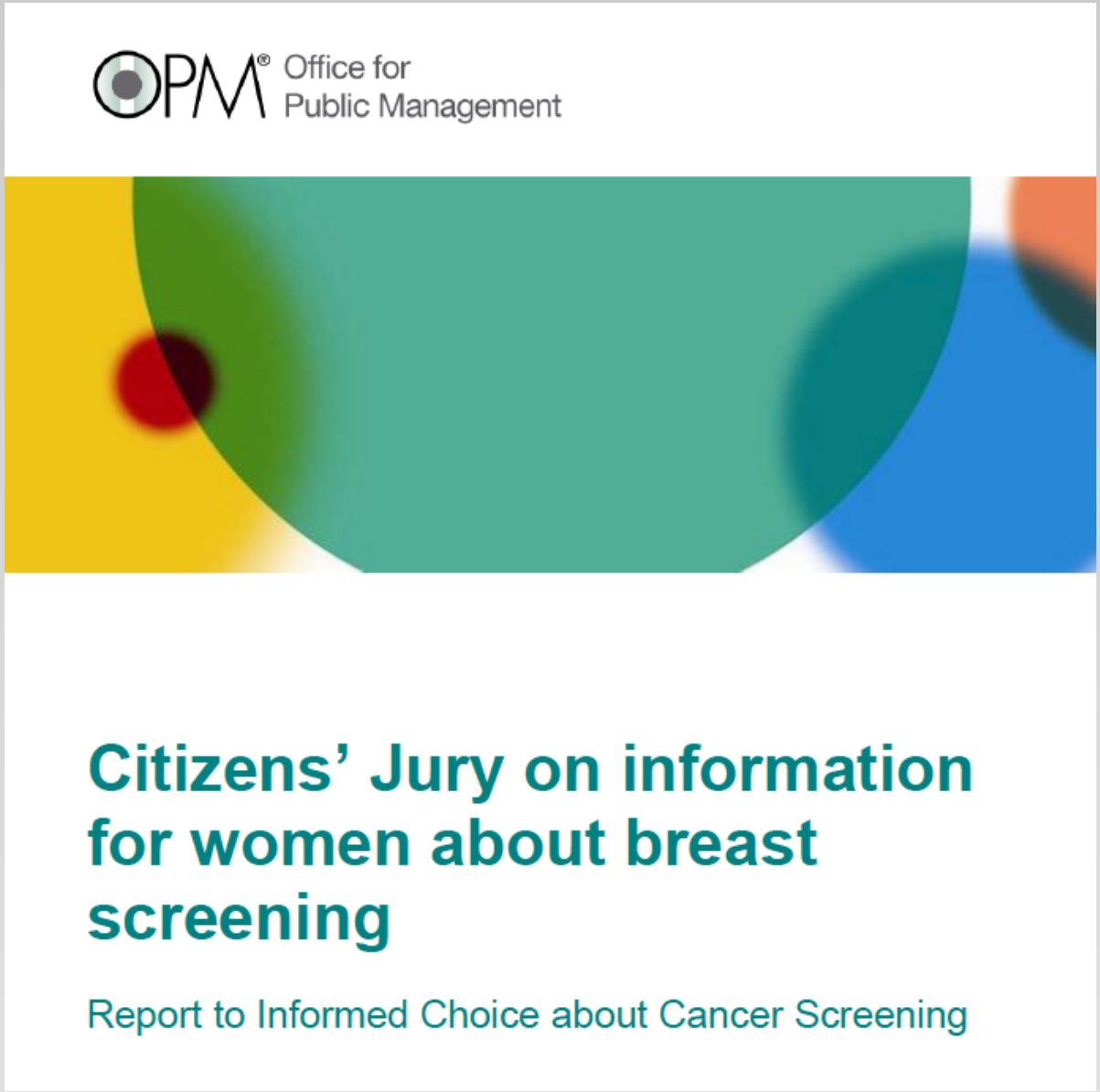
NonHDL Cholesterol: 4.6

BMI: 26.2

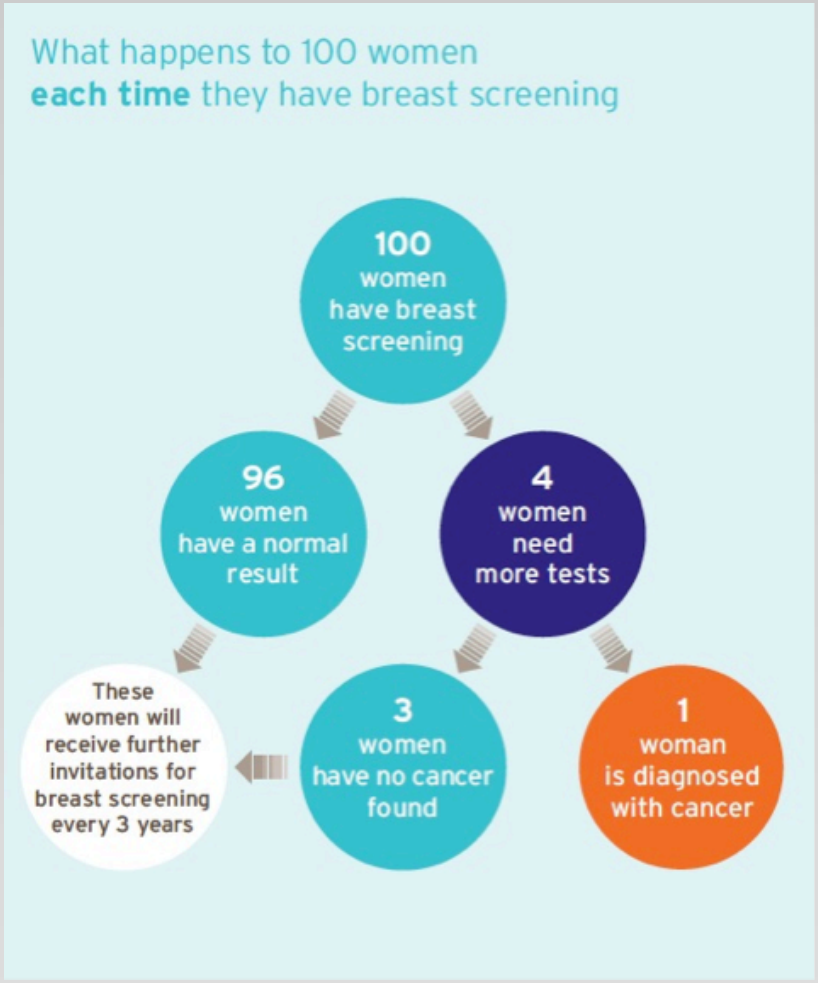
Reset

New UK Cancer Screening leaflets, 2013

- *"Consider the offer"*
- Presents pros and cons
- Does not make recommendation
- 'Uniform reporting of harms and benefits



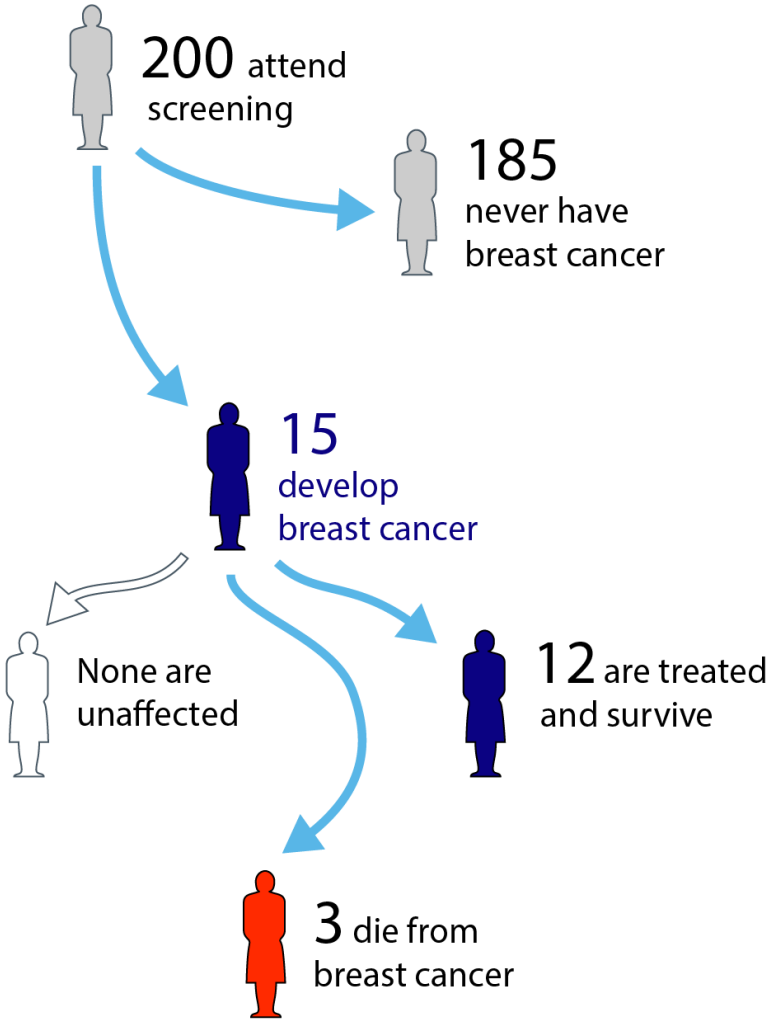
Public engagement through *Citizens' Jury*



Now in GCSE Maths syllabus:

> ***{calculate and interpret conditional probabilities through representation using expected frequencies with two-way tables, tree diagrams and Venn diagrams}.***

200 women between 50 and 70 who attend screening



A numeracy paradox?

- Leaflets optimised for people with low numeracy
- Those people tend to be less interested in shared-care / informed-choice

Health Psychology
2011, Vol. 30, No. 3, 336–341

© 2011 American Psychological Association
0278-6133/11/$12.00 DOI: 10.1037/a0022723

Do Low-Numeracy People Avoid Shared Decision Making?

Mirta Galesic
Max Planck Institute, Berlin, Germany

Rocio Garcia-Retamero
University of Granada

Brief comments on **2-way** risk communication

- Understand concerns/beliefs of audiences
- Have humility to admit uncertainty
- Build trust by being trustworthy
- Treat audiences with respect
- 'One size does not fit all'
- Use of metaphor/analogy/story
- Transparent/balanced format for any numbers

Numbers

- We can use models and data to assess probabilities of future events
- But
  - We only model what we can, and choose to, model
  - "All models are wrong"
  - Assessments are contingent on assumptions
  - Strong role of judgement
- Numbers are *constructed*
- Need due humility

	Object of uncertainty			
Specification	*Events*	*Parameters / inputs*	*Models*	*'Values'/ losses*

Probability and evidence

Separate

probability

from underlying quantity/quality of

evidence

Strong legal analogies: cannot convict on probability alone, need substantial evidence

A level of *confidence* is expressed using five qualifiers: "very low," "low," "medium," "high," and "very high." It synthesizes the author teams' judgments about the validity of findings as determined through evaluation of evidence and agreement. Figure 1 depicts summary statements

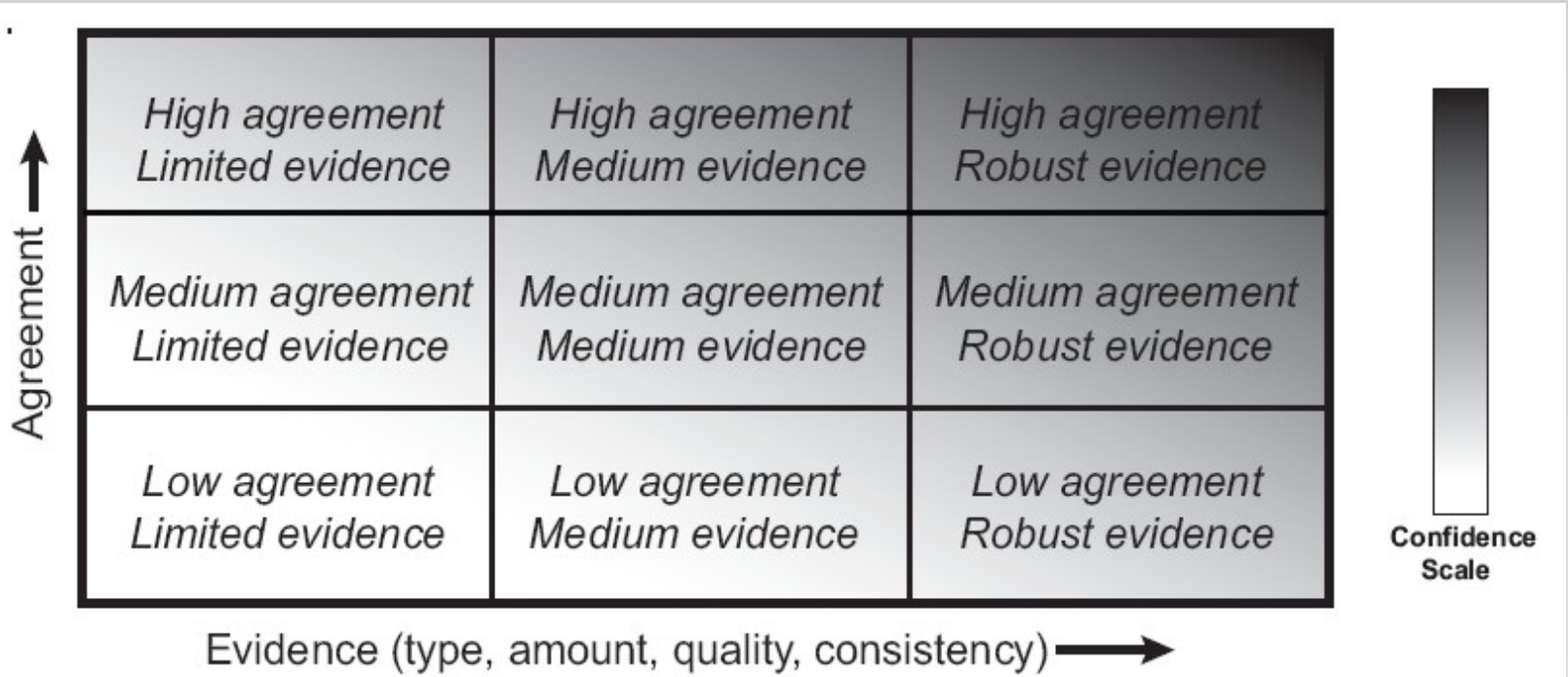


Figure 1: A depiction of evidence and agreement statements and their relationship to confidence. Confidence increases towards the top-right corner as suggested by the increasing strength of shading. Generally, evidence is most robust when there are multiple, consistent independent lines of high-quality evidence.

- Anthropogenic influences *likely* contributed to the retreat of glaciers since the 1960s and to the increased surface mass loss of the Greenland ice sheet since 1993. Due to a low level of scientific understanding there is *low confidence* in attributing the causes of the observed loss of mass from the Antarctic ice sheet over the past two decades. {4.3, 10.5}

Words of Estimative Probability

- Michael Morell, deputy director of the CIA *"Mr President, if we had a human source who had told us directly that Bin Laden was living in that compound, I still wouldn't be above 60%"*
- President "In this situation, what you started getting was probabilities that disguised uncertainty as opposed to actually providing you with more useful information."

Intelligence and National Security, 2014
http://dx.doi.org/10.1080/02684527.2014.885202

Routledge
Taylor & Francis Group

ARTICLE

Handling and Mishandling Estimative Probability: Likelihood, Confidence, and the Search for Bin Laden

JEFFREY A. FRIEDMAN* AND RICHARD ZECKHAUSER

Says

1) experts should combine their multiple assessments before passing to decision-maker ☹

2) "*assessments of confidence are most useful when they indicate the extent to which estimative probability might shift in response to newly gathered information*" ☺

How can we communicate deeper uncertainties due to the limitations of the evidence?

High quality	Further research is very unlikely to change our confidence in the estimate of effect
Moderate quality	Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate
Low quality	Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate
Very low quality	Any estimate of effect is very uncertain

Part of (old) GRADE scale used in Cochrane Collaboration and 25 other organisations to assess confidence in estimates of medical treatment effects

My personal star rating system for evidence

****	We understand the underlying process. Although we cannot predict what is going to happen, we can provide good numerical assessments.
***	We are reasonably confident in our analysis. We can expect numbers to change as we learn more, but not sufficient to justify major policy shifts.
**	New evidence could have a substantial impact on our assessment, although no major new surprises are expected. We encourage a robust decision-making approach with some precaution and adaptivity.
*	We have very limited understanding of the process or possibilities. Resilience to unexpected occurrences is called for.

Crises

John Krebs in the BSE crisis

- We do not know whether BSE has got into sheep.

  [acknowledging uncertainty]
- We are on the case. Here is what we are doing to try to find out.

  [reducing uncertainty]
- In the meantime we are not advising you to stop eating lamb. But if you are worried about it, change your diet.

  [self-efficacy, apply own risk-thresholds]
- We shall get back to you when we have worked more on establishing the actual uncertainty and risk.

  [precaution as temporary step, adaptable]

Mirror
Fri 10th Jun 2011 2:23pm

Killer cucumber bug is mutant E. coli strain

by Mike Swain, Daily Mirror 3/06/2011

Recommend 66 recommendations. Sign Up to see what your friends recommend.

Tweet 4

1990: John Gummer – ‘beef is safe’

1992: three cows in every 1,000 in Britain had BSE

1996: government admits link between BSE and the human form of the disease, new variant CJD

Policy advice in an ideal world…

- Seek transparency and ease of interrogation of any model
- Clear expression of the provenance of assumptions
- Acknowledge multiplicity of viewpoints
- Communicate the estimates with humility
- Communicate the uncertainty with confidence.
- Fully acknowledge the role of judgement.

Why bother to communicate well?

- Duty
- To cover yourself
- Prevent problems
- Ethics
- Breeding "immunity to misleading anecdote"

Reducing the Influence of Anecdotal Reasoning on People's Health Care Decisions: Is a Picture Worth a Thousand Statistics?

Angela Fagerlin, PhD, Catharine Wang, PhD, Peter A. Ubel, MD

Confidence in analyses

- 'Confidence' usually thought to depend on available evidence
- But crucially depends on what might be available
- Consider an unknown quantity θ
- [θ might be an 'unknown risk' – what we would conclude with all potential info]
- Estimate and uncertainty about expressed as $E[\theta]$ and $V[\theta]$
- These quantities would become $E[\theta|X]$ and $V[\theta|X]$ if we had an extra info X
- We may feel lack of confidence if $E[\theta|X]$ and $V[\theta|X]$ are very different from $E[\theta]$ and $V[\theta]$

Confidence in analyses

- If using full, believed-adequate model, then potential influence of X is taken account of, since

$$E[\theta] = E_X[\, E[\theta|X] \,]$$

[current estimate is the mean of what we expect that estimate to become on receipt of further info]

$$V[\theta] = E_X[\, V[\theta|X] \,] + V_X[\, E[\theta|X] \,]$$

[current uncertainty is 'mean of what we expect that uncertainty to become on receipt of further info' + 'the uncertainty about what the estimate might become']

- But if have not fully included X in the model (acknowledged inadequacies), these potential changes are not included
- So feel uncomfortable

Environment Agency

Enter a postcode or place name: CB5 8HL Go

Other topics for this area... Flood Map for Planning (Rivers and Sea)

Flood Map for Planning (Rivers and Sea)

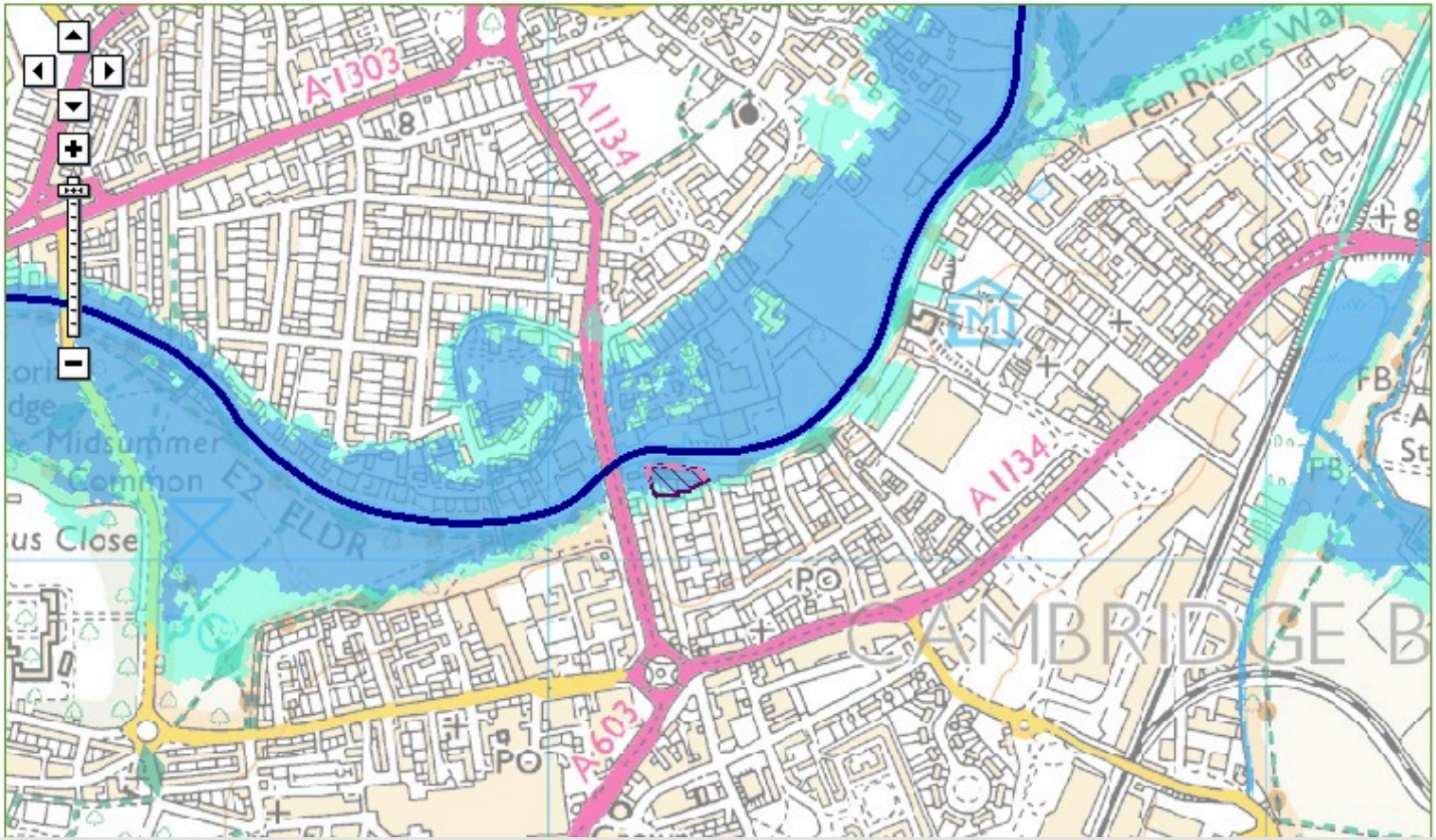
Map legend

Click on the map to see what Flood Zone (National Planning Policy Guidance definitions) the proposed development is in.

- Flood Map for Planning (Rivers and Sea)
  - Flood Zone 3
  - Flood Zone 2
  - Flood defences (Not all may be shown*)
  - Areas benefiting from flood defences (Not all may be shown*)
- River and Sea levels
  - Main rivers

CB5 8HL at scale 1:10,000

Other maps · Data search · Text only version



Flood Zone definitions are set out in the National Planning Policy Guidance:

* Flood Zone 1 - land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding (<0.1%)
* Flood Zone 2 - land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%), or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% – 0.1%) in any year
* Flood Zone 3 - land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%), or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year