

Communicating uncertainty without losing trust and credibility

David Spiegelhalter

*Chairman of the Winton Centre for Risk & Evidence Communication,
University of Cambridge*

President, Royal Statistical Society

EFSA Conference 2018



Winton Centre for Risk and Evidence Communication

wintoncentre@maths.cam.ac.uk

<https://wintoncentre.maths.cam.ac.uk>

 UNIVERSITY OF CAMBRIDGE

Not all numbers are reliable...

We send the EU **£350 million** a week

let's fund our **NHS** instead  Vote Leave

#TakeControl

Let's take back control

Bloomberg Markets: European Open

No Amount of Alcohol Use Is Safe

Digital Originals

August 24th, 2018, 1:00 PM GMT+0100

euronews.

Europe

World

More ▾

Programmes ▾

**BREAKING
NEWS**

Six dead in shooting in Bakersfield, California

Home > News > World > No amount of alcohol is safe for your health, study finds

WORLD

No amount of alcohol is safe for your health, study finds

By [Alice Tidey](#) • last updated: 24/08/2018

FREE METRO

Just one drink a day 'can increase risk of premature death'

Just one drink a day 'can increase risk of premature death'

BBC

David Spiegel...



News

Sport

Weather

iPlayer

TV

R

NEWS

Home

UK

World

Business

Politics

Tech

Science

Health

Family & Education

Health

No alcohol safe to drink, global study confirms

By Laurel Ives
BBC Health

🕒 24 August 2018



Share



GETTY IMAGES

Just one drink a day leads to health risks

Is there no safe level of drinking?

Alcohol use and burden for 195 countries and territories, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016

GBD 2016 Alcohol Collaborators*

Lancet, August 2018

“Our results show that the safest level of drinking is none.”

So what did they find for light drinking?

Lancet Press release

- *...drinking one alcoholic drink a day increases the annual risk of developing one of the 23 alcohol-related health problems by 0.5%, compared with not drinking at all*
- *... from 914 people in 100,000 non-drinkers to 918 in 100,000 for people who consume one alcoholic drink a day”*
- These **expected frequencies** are not in the paper
- The Lancet Press office had to get them from the authors
- Lancet Guidelines: *“For risk changes or effect sizes, give absolute values rather than relative changes”*

Putting things in perspective - 1

- This means 25,000 people, having one drink a day for a year, gives rise to one extra serious health event
- New unit? *Number Needed to Drink (NND)*

Putting things in perspective - 2

- One 10g drink a day is 3.65 kg of alcohol a year
- Equivalent to 16 x 70cl 40% ABV bottles of gin a year



- For 25,000 people, this is *400,000 bottles of gin* to get one serious health event

What about uncertainty?

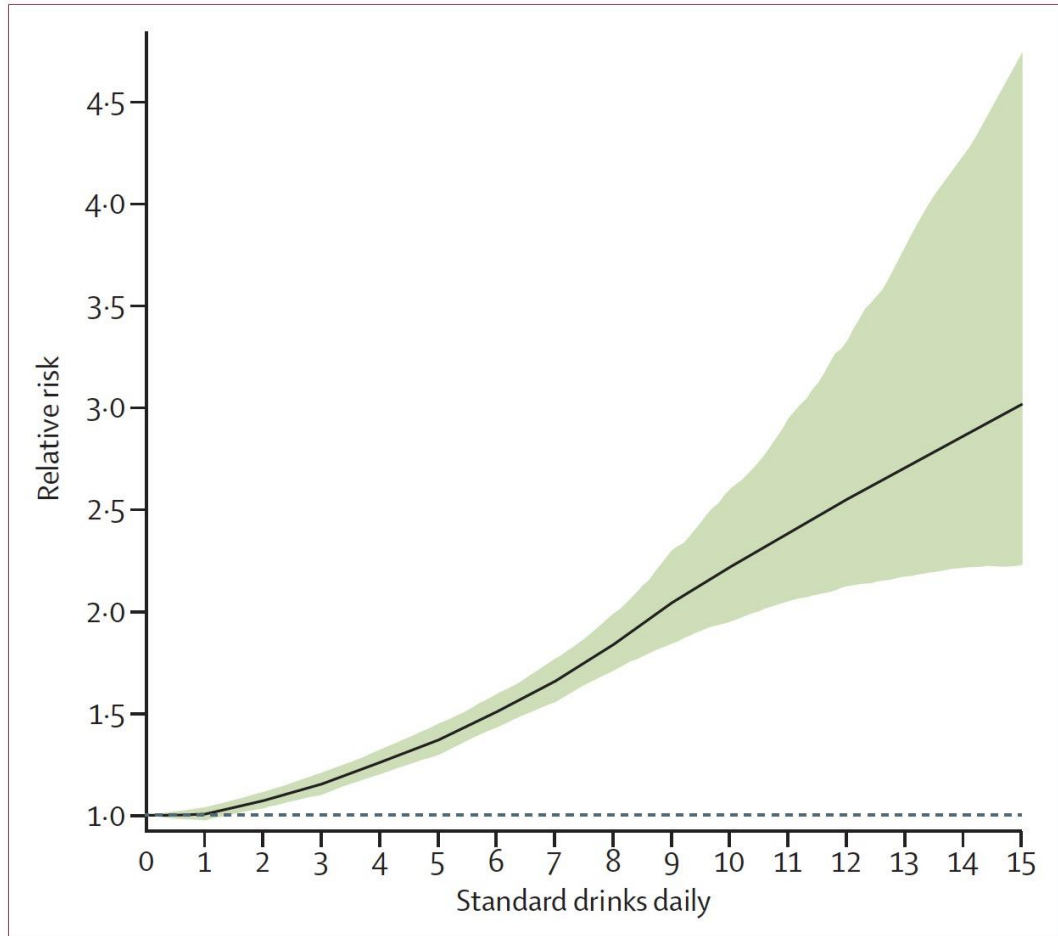
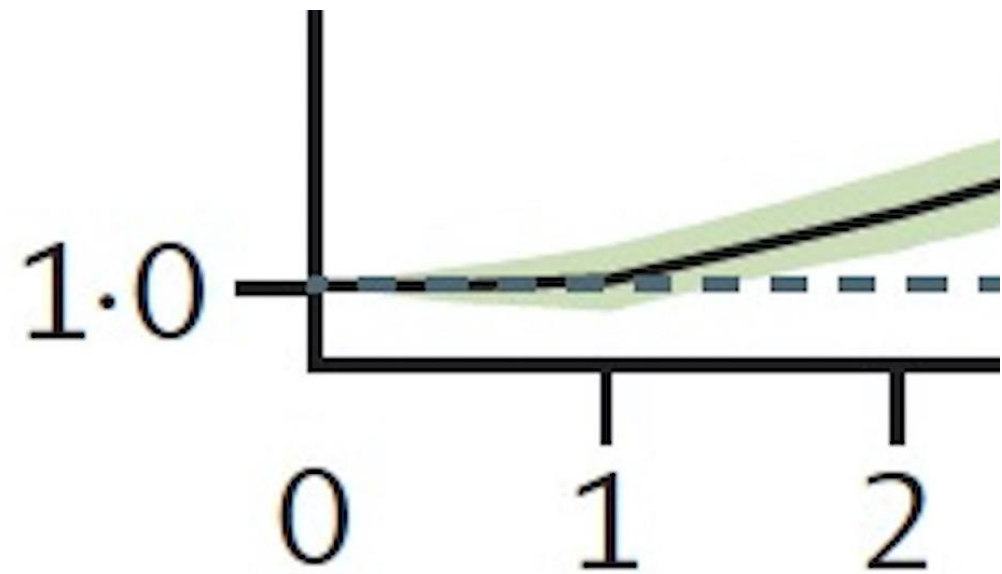


Figure 5: Weighted relative risk of alcohol for all attributable causes, by standard drinks consumed per day

Age-standardised weights determined by the DALY rate in 2016, for both sexes. The dotted line is a reference line for a relative risk of 1. DALY=disability-adjusted life-year.



- Not even confident there is harm at one drink
- So how good are these headlines?!

‘Expected frequencies’ are now in UK GCSE Maths syllabus:



Categories

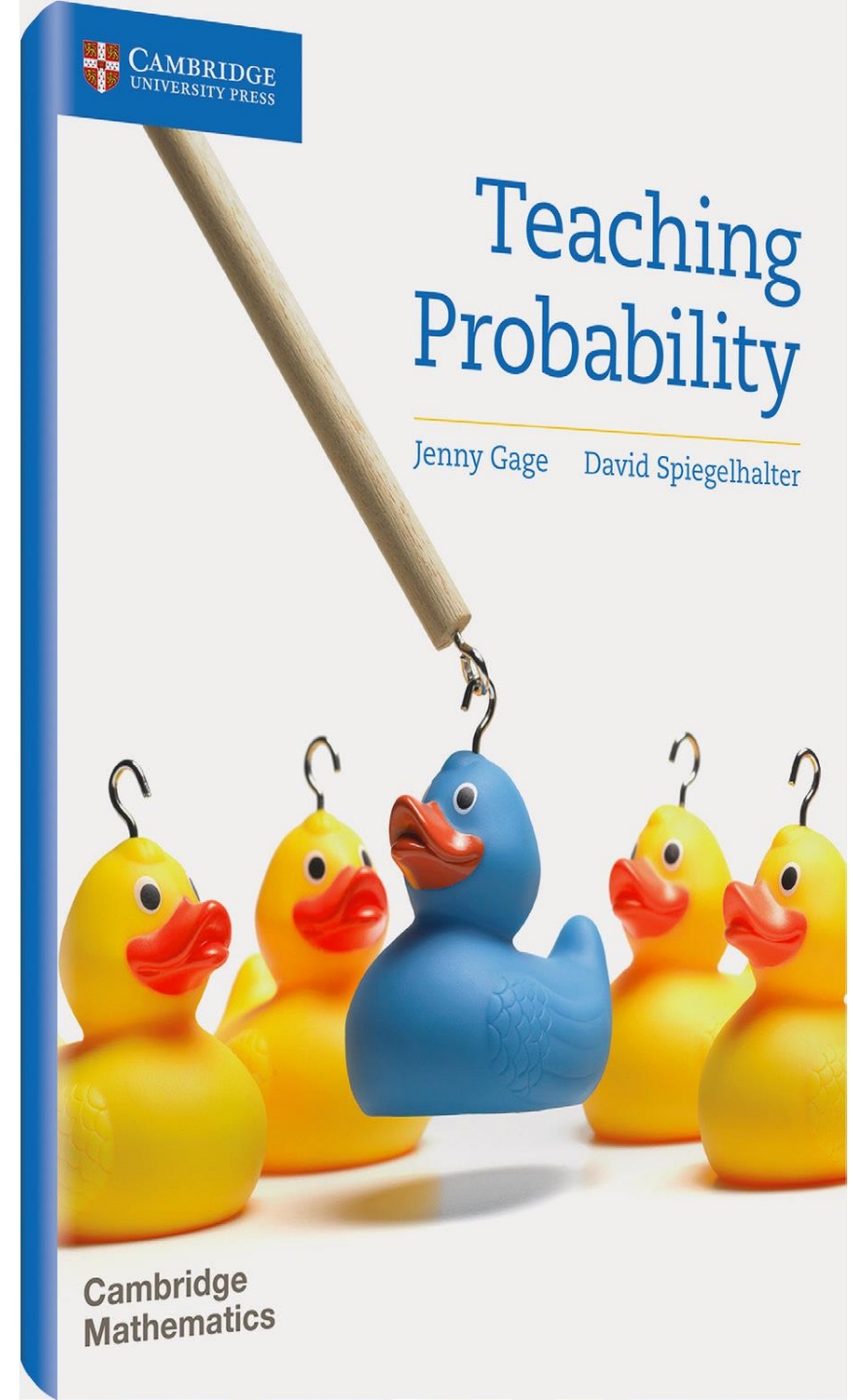
Courses

Programs

ONLINE COURSE

Teaching Probability

Learn how to create effective lessons on probability to help equip 11 - 16 year olds with skills for life.



23rd January
2017

News

Browned toast and crispy roast potatoes 'a potential cancer risk'



Acrylamide
(again)

22nd January
2017

Winton Centre for Risk and Evidence Communication

[Home](#)

[About](#)

[People](#)

[What we do](#)

[News](#)

[Blog](#)

[Events](#)

Winton Centre for Risk and Evidence
Communication ^

News

How dangerous is burnt toast?

Submitted by David Spiegelhalter on Sun, 22/01/2017 - 13:04

Events



23rd January
2017
11.15

MailOnline

DON'T fear potatoes (or burnt toast!) Food Standards Agency back-tracks over cancer link to spuds

- Food officials say crunchy roast potatoes and burnt toast are both 'danger foods'
- This is because they have higher levels of acrylamide - a highly toxic compound
- But a statistician said someone would need to eat 320 slices of toast to be at risk
- And the FSA's chief scientific adviser now claims there is no reason to worry

By [STEPHEN MATTHEWS FOR MAILONLINE](#)

PUBLISHED: 11:15, 23 January 2017 | **UPDATED:** 15:30, 23 January 2017



NEWS

[Home](#)[UK](#)[World](#)[Business](#)[Politics](#)[Tech](#)[Science](#)[Health](#)[Family & Education](#)[US & Canada](#)

Coffee sold in California must carry cancer warning, judge rules

🕒 30 March 2018



 Share



'Manipulative' risk communication

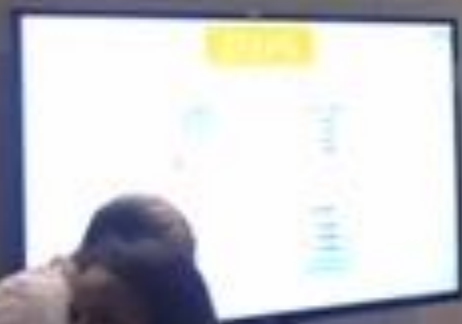
- Often **not** the fault of journalists
- So who can we trust about risks?

TRUSTED SCIENCE FOR SAFE FOOD

EFSA
Journal

Professional
opportunities

EU-FORA
Fellowship
Programme



Baroness Onora-O'Neill..

- Organisations should not be aiming to 'increase trust'
- Rather, aim to demonstrate *trustworthiness*
- Information should be
 - *accessible*
 - *intelligible*
 - *useable*
 - *assessable*



Risk assessment in a societal context...

- Requires trustworthy communication
- This means acknowledging uncertainty
- And 'showing your working' to those that want to see it

Flipping coins



We might be uncertain about..

The future –

- *can't know*
- aleatory uncertainty

Facts and science -

- *don't know*
- epistemic uncertainty

Epistemic uncertainty

Can we communicate uncertainty about facts, numbers and science, in a trustworthy way?

We may not know about..

- Single facts
 - What caused a particular event.
- Directly (in theory) measurable statistics
 - Consumption of particular foods.
- “Virtual” quantities that can only be inferred
 - Current risks from a food ingredient
- Science - how the world works
 - Whether glyphosate is a carcinogen

Communicating uncertainty about a quantity

1. Full probability distribution
2. Summary of distribution
3. Range
4. Pre-defined categorisation, eg 'likely'
5. Verbal qualifier
6. List of possibilities
7. Mention possibility of error
8. Don't mention uncertainty
9. Deny any possibility of uncertainty

Uncertainty about statistics

[Home](#) [UK](#) [World](#) [Business](#) [Politics](#) [Tech](#) [Science](#) [Health](#) [Family & Education](#)

[Business](#) [Your Money](#) [Market Data](#) [Markets](#) [Companies](#) [Economy](#)

UK unemployment falls to 1.44 million

© 24 January 2018 | 1350

[f](#) [Twitter](#) [WhatsApp](#) [Email](#) [Share](#)



UK unemployment fell by 3,000 to 1.44 million in the three months to November, official figures show.

The number of those in work increased sharply and wages rose at their fastest rate in almost a year, the Office for National Statistics said.

Uncertainty about statistics

Home UK World Business Politics Tech Science Health Family & Education

Business | Your Money | Market Data | Markets | Companies | Economy

UK unemployment falls to 1.44 million

© 24 January 2018 | 1350

[f](#) [Twitter](#) [WhatsApp](#) [Email](#) [Share](#)



GETTY IMAGES

UK unemployment fell by 3,000 to 1.44 million in the three months to November, official figures show.

The number of people in work increased sharply in almost a year, and wages rose at their fastest rate since 2012, the Office for National Statistics said.

Uncertainty about statistics

Office for National Statistics

Home | UK | World | Business | Politics | Tech | Science | Health | Family & B

Business | Your Money | Market Data | Markets | Companies | Economy

Release calendar | Meth

UK unemployment falls to 1.44 million

© 24 January 2018 | 1350

f | | | |

Home | Business, industry and trade | Economy | Employment and labour market | People, population and communities

Search for a keyword(s) or time series ID

Home > Employment and labour market > People in work > Employment and employee types > UK labour market

Statistical bulletin:

UK labour market: January 2018

Estimates of employment, unemployment, economic inactivity and other employment-related statistics for the UK.



UK unemployment fell by 3,000 to 1.44 million the three months to November. Official figures show.

The number of people in work increased sharply and wages rose at their fastest rate in almost a year, said.

Uncertainty about statistics

Home UK World Business Politics Tech

Business Your Money Market Data Markets

UK unemployment falls 1

© 24 January 2018 | 1350



UK unemployment fell by 3,000 to 1.44 million in November, official figures show.

The number of people in work increased sharply and wages rose at their fastest rate in almost a year, said.

Table of contents

1. Main points for September to November 2017
2. Summary of latest labour market statistics
3. Things you need to know about this release
4. Employment
5. Public and private sector employment (first published on 13 December 2017)
6. Actual hours worked
7. Workforce jobs (first published on 13 December 2017)
8. Average weekly earnings
9. Labour disputes (not seasonally adjusted)
10. Unemployment
11. Economic inactivity
12. Young people in the labour market
13. Redundancies
14. Vacancies
15. Future publication dates
16. Links to related statistics
17. Quality and methodology

Uncertainty about statistics

Home UK World Business Politics Tech Science Health Family & Education

Business Your Money Market Data Markets

UK unemployment falls to 1.44 million

© 24 January 2018 | 1350



UK unemployment fell by 3,000 to 1.44 million in November, official figures show.

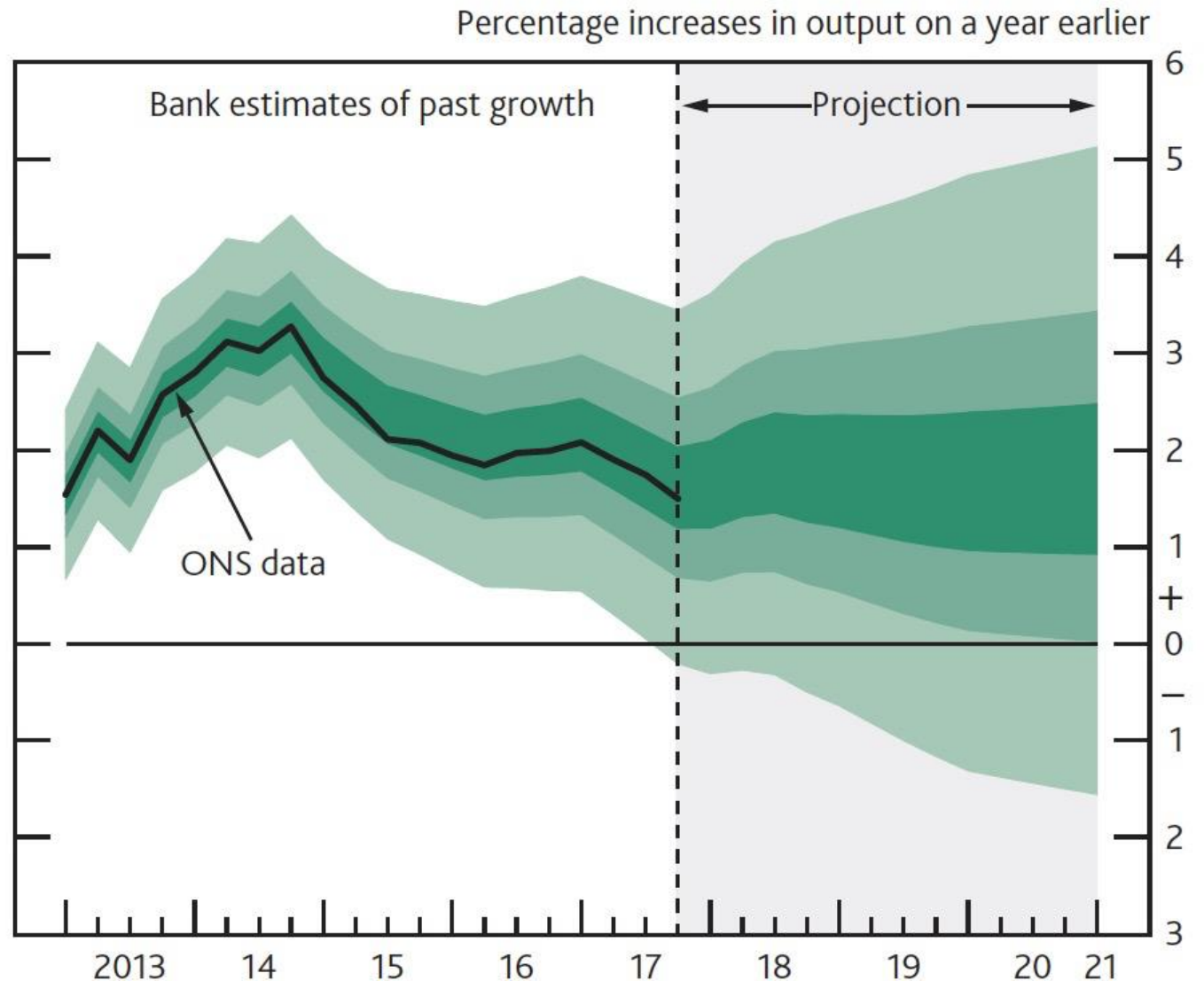
The number of people in work increased sharply and wages rose at their fastest rate in almost a year, the Office for National Statistics said.

As well as calculating precision measures around the numbers and rates obtained from the survey, we can also calculate them for changes in the numbers. For example, for September to November 2017, the estimated change in the number of unemployed people since June to August 2017 was a small fall of 3,000, with a 95% confidence interval of plus or minus 77,000. This means that we are 95% confident the actual change in unemployment was somewhere between an increase of 74,000 and a fall of 80,000, with the best estimate being a small fall of 3,000. As the estimated fall in unemployment of 3,000 is smaller than 77,000, the estimated fall in unemployment is said to be “not statistically significant”.

February 2018 Inflation report

- ONS do not provide 'error' on GDP

GDP projection (wide bands)(a)(b)



Communicating epistemic uncertainty

- A. Direct:** expression of uncertainty about fact or number or science

- B. Indirect:** Summary of quality of underlying evidence

Guidance Note for Lead Authors of the IPCC Fifth Assessment Report on Consistent Treatment of Uncertainties

Table 1. Likelihood Scale

Term*	Likelihood of the Outcome
<i>Virtually certain</i>	99-100% probability
<i>Very likely</i>	90-100% probability
<i>Likely</i>	66-100% probability
<i>About as likely as not</i>	33 to 66% probability
<i>Unlikely</i>	0-33% probability
<i>Very unlikely</i>	0-10% probability
<i>Exceptionally unlikely</i>	0-1% probability

Communicating confidence in the science / strength of evidence

IPCC

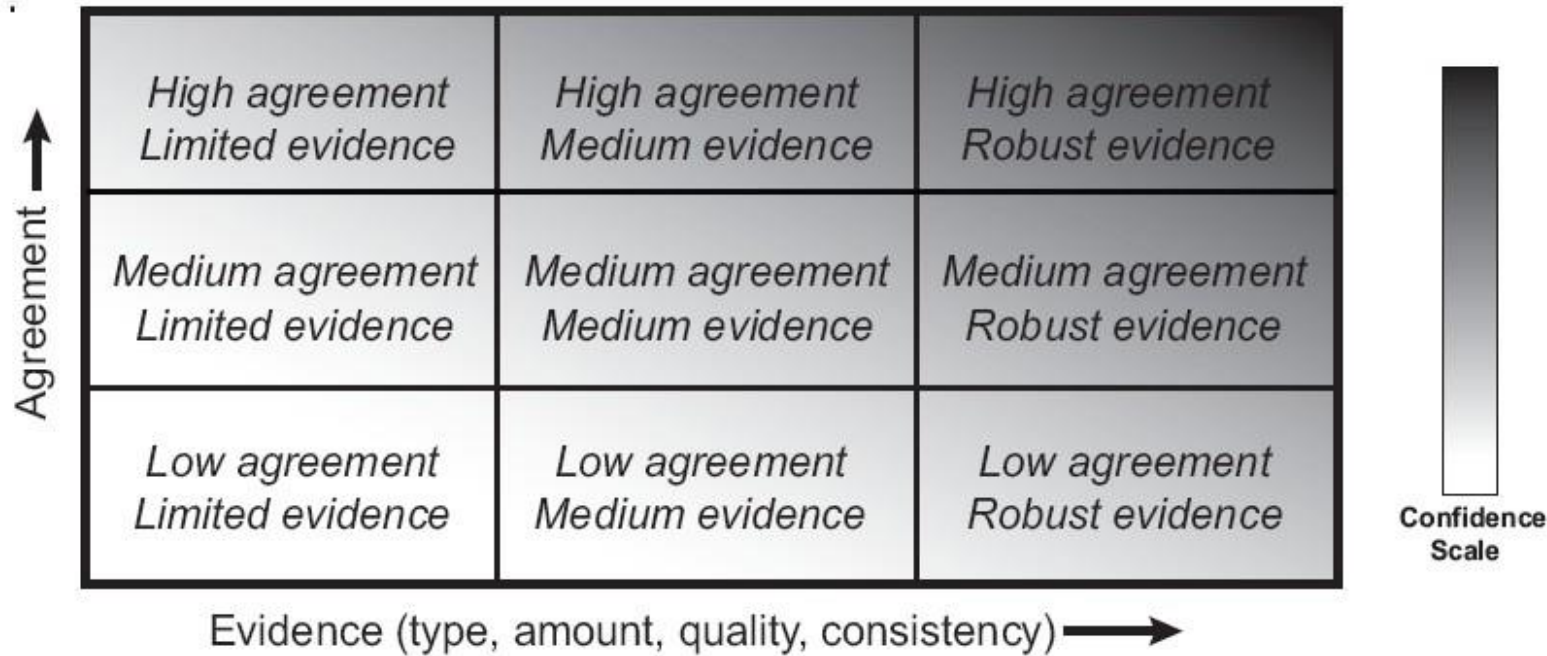


Figure 1: A depiction of evidence and agreement statements and their relationship to confidence. Confidence increases towards the top-right corner as suggested by the increasing strength of shading. Generally, evidence is most robust when there are multiple, consistent independent lines of high-quality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

UK What Works Centres



Toolkit Strand ^

Cost v

Evidence Strength v Months Impact

Arts participation

Low impact for low cost, based on moderate evidence.



+2

Aspiration interventions

Very low or no impact for moderate cost based on very limited evidence.



0

Behaviour interventions

Moderate impact for moderate cost, based on extensive evidence.



+4

Block scheduling

Very low or no impact for very low or no cost, based on limited evidence.



0

Collaborative learning

Moderate impact for very low cost, based on extensive evidence.



+5

MAGIC team – benefits and harms of medical treatments

Quality of evidence

★★★★ Moderate

★★★★ Moderate

★★★★ Moderate

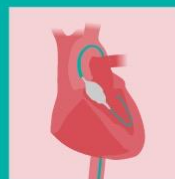
★★★★ Moderate

★★★★★ High

★★★★★ High

★★★★ Moderate

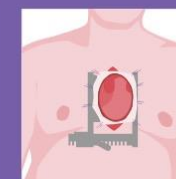
Choice of intervention for those with severe aortic stenosis



Transfemoral TAVI

Inserting a new valve into the aortic valve's place without open heart surgery. Delivery is through the femoral artery.

or



SAVR

Open-heart surgery, to remove the narrowed aortic valve. Replacement with tissue valve.

Recommendations

Population

Favours TAVI

Favours SAVR

Age 85+

Strong

Why? ▾

Comparison of benefits and harms

	Favours transfemoral TAVI		Favours SAVR		Quality of evidence
	Events per 1000 people – within 2 years				
Deaths	197	45 fewer	242		★★★★ Moderate
Strokes	79	20 fewer	99		★★★★ Moderate
Aortic valve reinterventions	10		7 fewer	3	★★★★ Moderate
Pacemaker insertions	226		134 fewer	92	★★★★ Moderate
Life-threatening bleeds	161	252 fewer	413		★★★★ High
New onset atrial fibrillation	134	178 fewer	312		★★★★ High
Moderate / severe heart failure	87		18 fewer	69	★★★★ Moderate
	Events per 1000 people – within 10 years				
Aortic valve reinterventions	226		134 fewer	92	★★★★ Very low
	Length of hospital stay				
Median days in hospital	8	4 fewer	12		★★★★ High

Randomised trial of communicating epistemic uncertainty

- **Topics:**

- Number unemployed,
- Tigers in India,
- Global temperature change

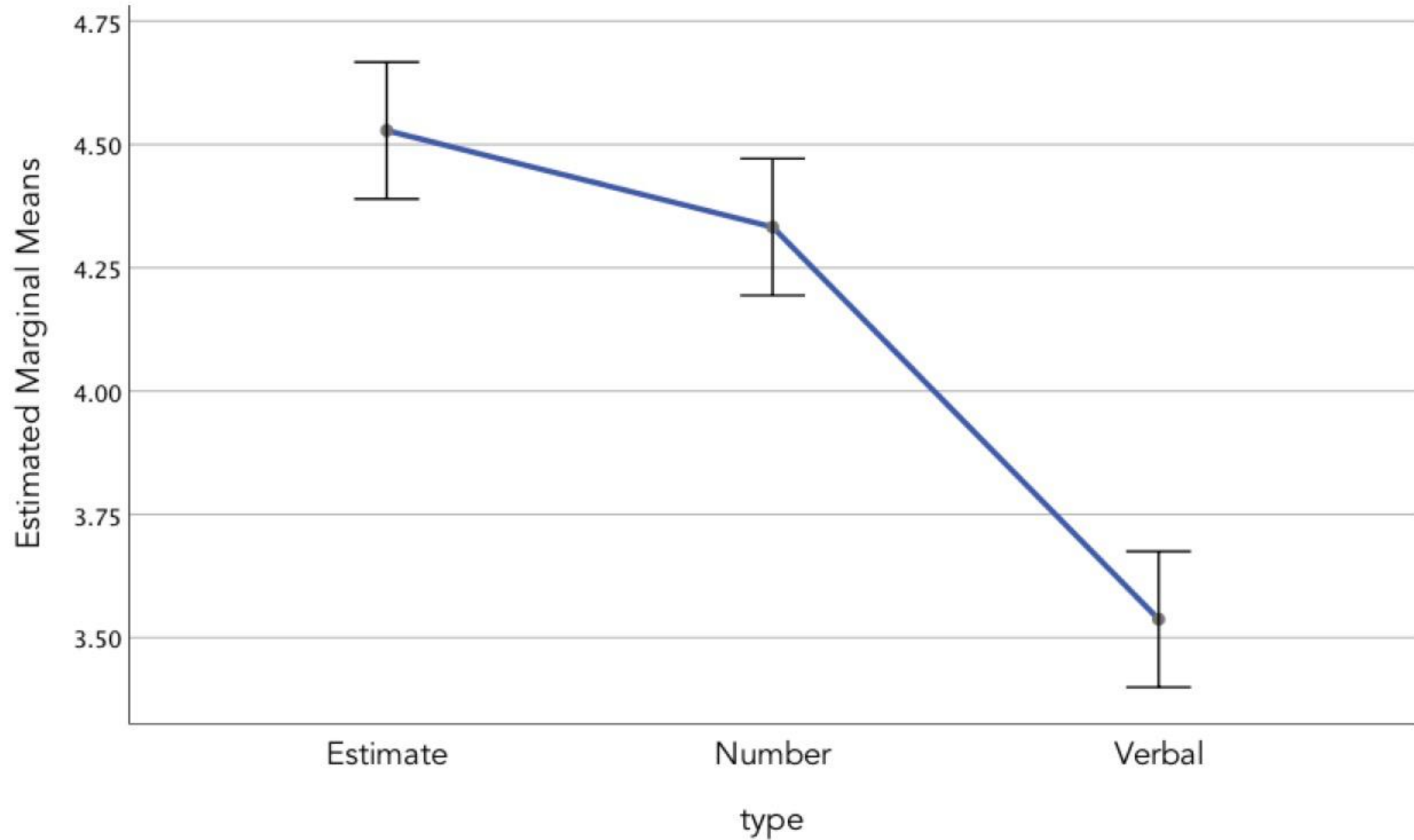
- **Format:**

- Estimate
- Range
- Verbal qualifier,

- **Trust/credibility:** in number and source

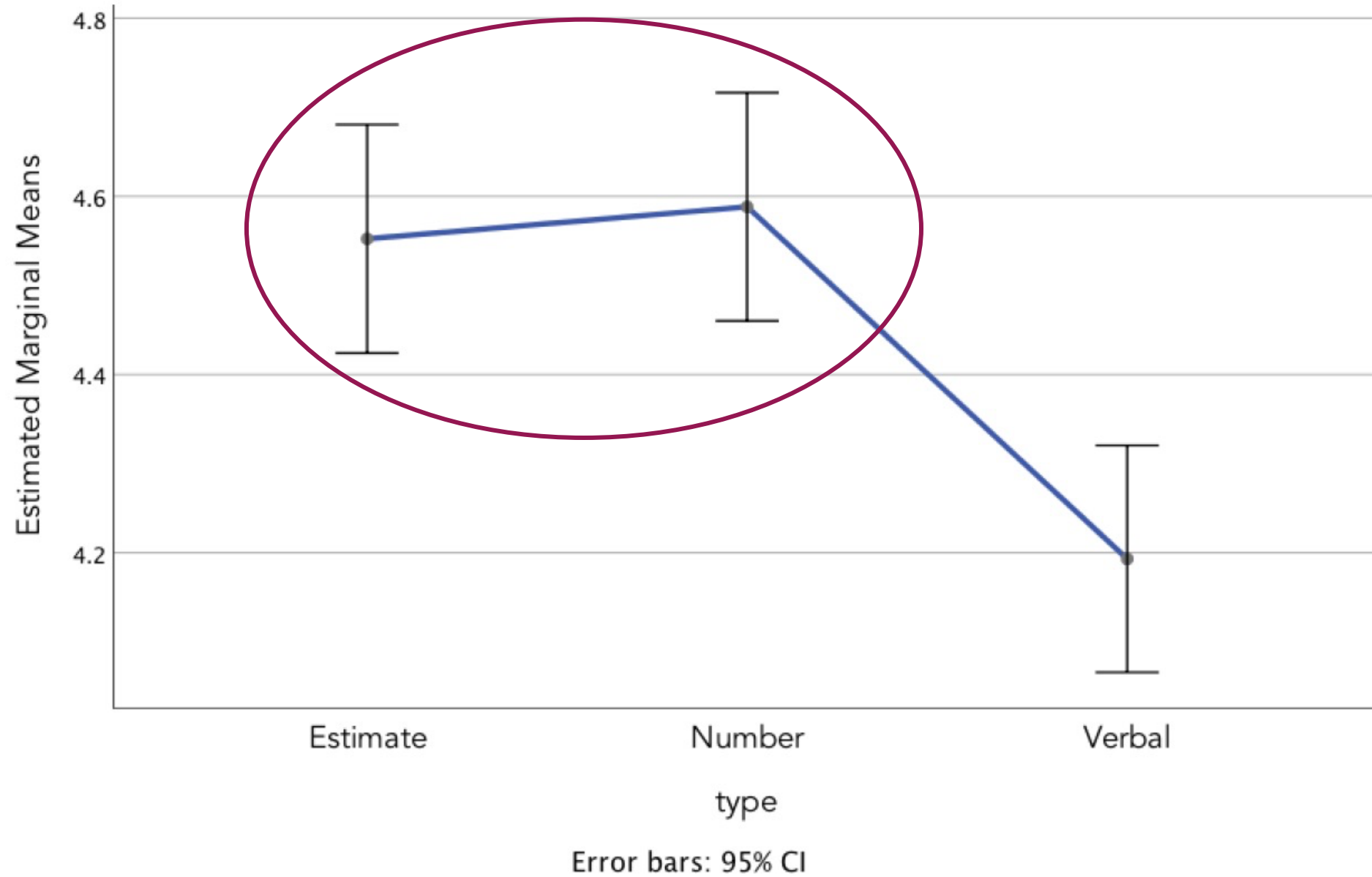
- **Design:** Online panel, between-person, 1126 participants

To what extent do you think this number is trustworthy?



Error bars: 95% CI

To what extent do you think the writers of the report are trustworthy?



Migration statistics are highly political, but uncertain

Statistical bulletin:

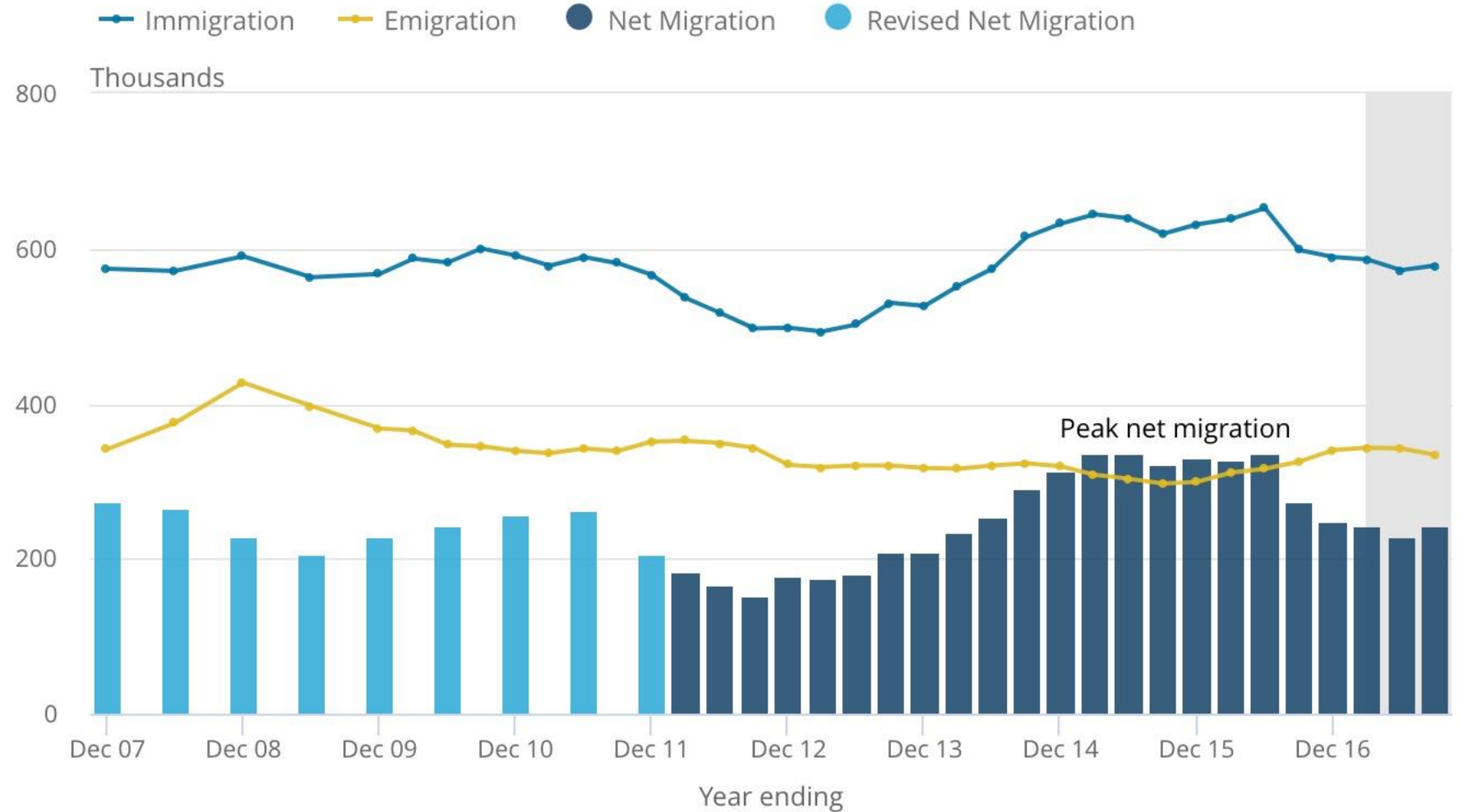
Migration Statistics Quarterly Report: July 2018
(rescheduled from May 2018)

Our best assessment shows around 280,000 more people coming to the UK than leaving in 2017

February 2018 report

Figure 1: Long-Term International Migration

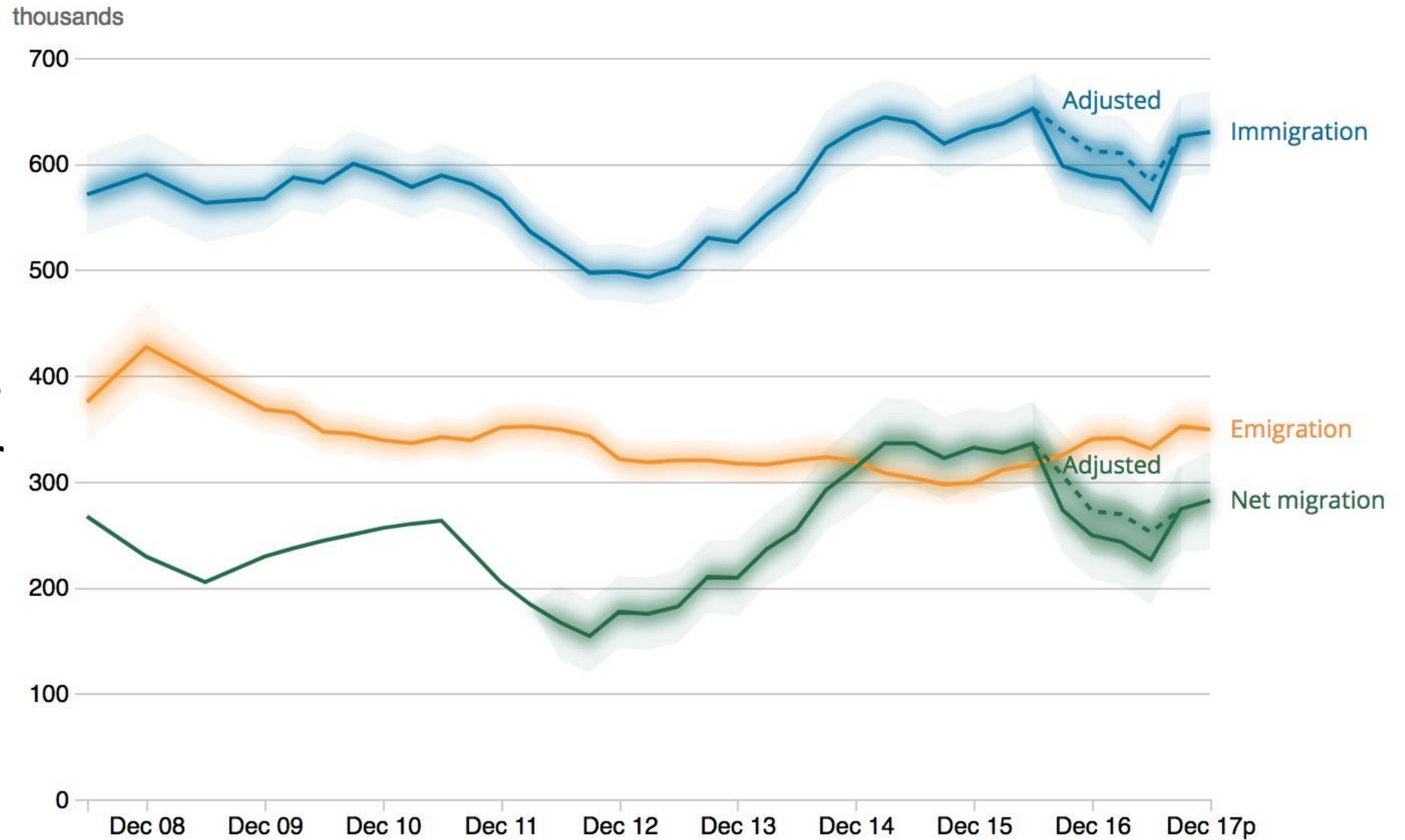
UK, 2007 to 2017 (year ending September 2017)



Source: Long-Term International Migration, Office for National Statistics

August
2018
report

Figure 1: Long-Term International Migration, UK,
2008 to 2017

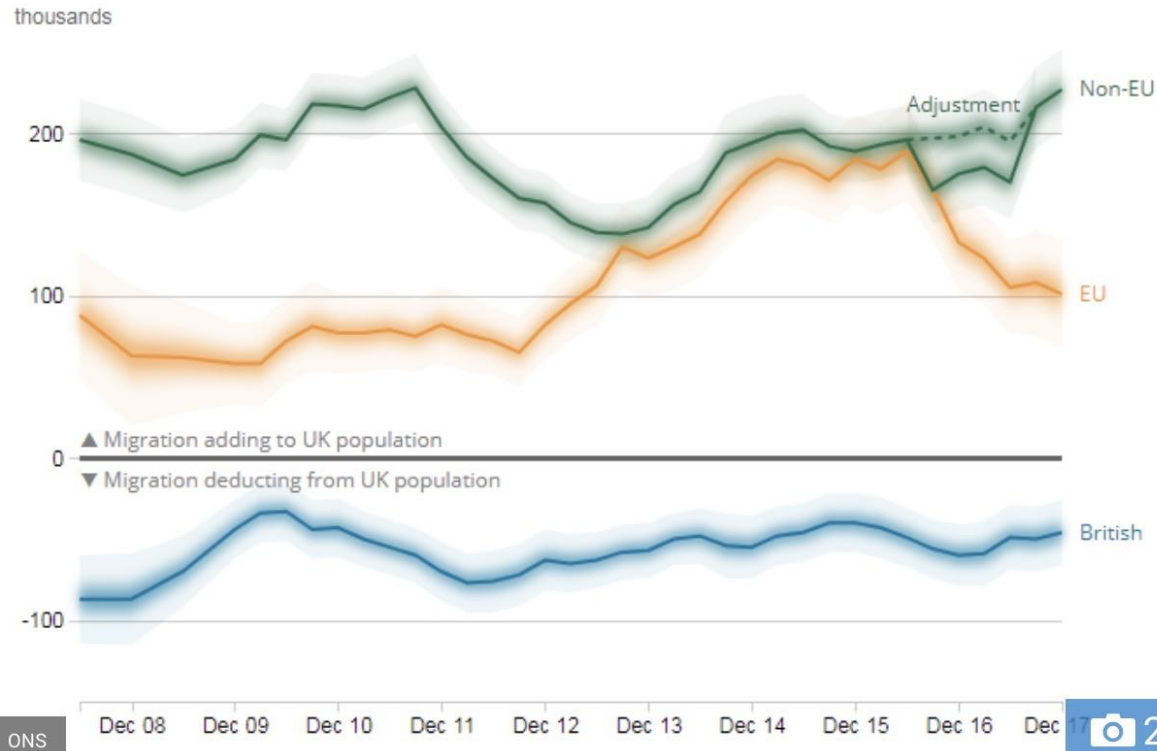


Source: Long-Term International Migration, Office for National Statistics

- Only visualises sampling error

- Quality issues as verbal caveats

Figure 3: Net migration to the UK by citizenship, UK, 2008 to 2017



The number of non-EU migrants is on the rise, whereas Europeans are not coming to the UK in as many numbers as before

She added: "More EU nationals continue to arrive than leave and as the ONS have made clear, net migration has been broadly stable since late 2016. But while it is not unusual to see quarterly ups and downs, we know more needs to be done if we are to bring net migration down to sustainable levels."

And ONS Migration statistician Nicola White said: "Net migration fell following record levels in 2015 and early 2016 and has been broadly stable since. This is similar to the



EIGHT-LEGGED FREAKS Venomous tarantulas the size of dinner plates on loose in UK



BUG ALERT Outbreak of nasty bacteria in Canary Islands poses threat to Brit holidaymakers



FLOURY LANGUAGE This Morning fans baffled by Nadine Coyle's accent as she says 'flour'

Trustworthy communication of uncertainty

- **Intelligent transparency:** *accessible, intelligible, useable, assessable*
- **Be confident about uncertainty**
- **Listen to audiences**, and test all outputs
- **Vigorously pre-empt misunderstandings**
- **'Star-ratings'** for underlying quality of evidence?
- **Work closely** with communication professionals and journalists