GCSE and A level Geography 2016

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Introduction to Data Skills in Geography, funded by the Nuffield Foundation

Simon Pinfield

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Data Skills in Geography - Main aims

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To support teachers and students in their:

- understanding of data skills;
- confidence in their use and application, including integration of the skills into lesson plans; and
- knowledge of their value to further study and employment.

The programme will also raise awareness in both Higher Education and in schools about the current change in demand for data skills within Geography GCSE, A Level and the Geography QAA benchmark. We aim to upskill the teachers of today and enhance the abilities of the teachers of tomorrow.

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How will the RGS-IBG do this?

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- Production of online teaching resources for the new GCSE and A Level specifications, based around topics and fieldwork skills, to be published at www.rgs.org/dataskills
- CPD events, including partnership events, such as this one
- HE input / liaison and work with ITT institutions
- Strengthening existing networks and creating new ones

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How to get involved...

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- Attending CPD events, like this one
- Using the RGS-IBG resources (visit www.rgs.org/dataskills), when available, and collaborating with others to share good practice
- Offering to work with other schools and perhaps leading a cluster group (new or existing)
- Using the RGS-IBG short units of work / lesson plans for GCSE and A Level, written by teachers / other experts
- Using the Edexcel website for further advice and resources

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Contact

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W: www.rgs.org/dataskills

Funded by the Nuffield Foundation

Nuffield Foundation

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Today's event & ongoing support from Pearson

James Maxwell

james.maxwell@pearson.com

@GeogMaxwell

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Data Skills in Geography

10am – 4pm

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1. **What are quantitative skills?** *(10:30 – 11am)* by **Richard Harris**

2. **The value of data skills.** *(11:40 – 12.20pm)* by **David Holmes**

3. **Visualising data & the NEA.** *(1:10 – 1:50pm)* by **David Holmes**

4. **Data Analysis & Statistics.** *(1:55 – 2:35pm)* by **Simon Ward**

5. **Tackling units through the carbon cycle.** *(2:35 – 3:15pm)* by **Martin Evans**

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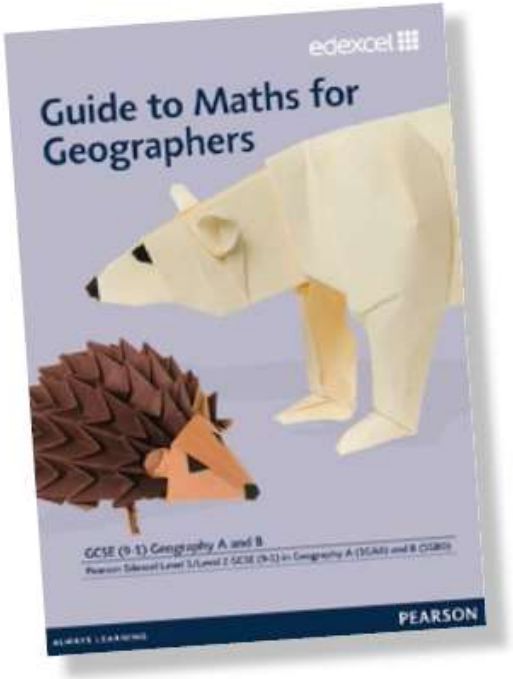
Guide to Maths for Geographers

Maths for Geographers guides for GCSE and AS/A level clearly detailing what is learnt in KS3 and GCSE Maths lessons and linking this to their geographical skills. The guides help teachers use terminology and approaches that are consistent with Maths so students can make links between the subjects. Accompanying skills worksheets will help build confidence and fluency as well as setting out how these skills will be assessed in the examinations.



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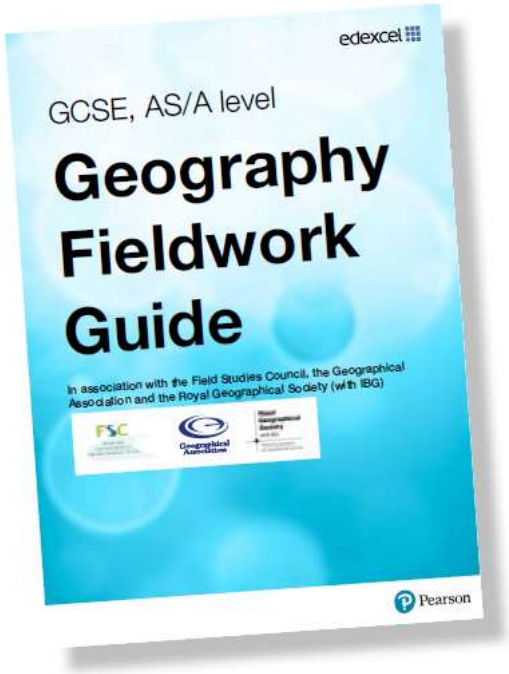

A top-level guide to planning high-quality fieldwork around your teaching, developed with the Field Studies Council, the Royal Geographical Society and the Geography Association to ensure that field trips are meaningful and successfully prepare student for the exams.

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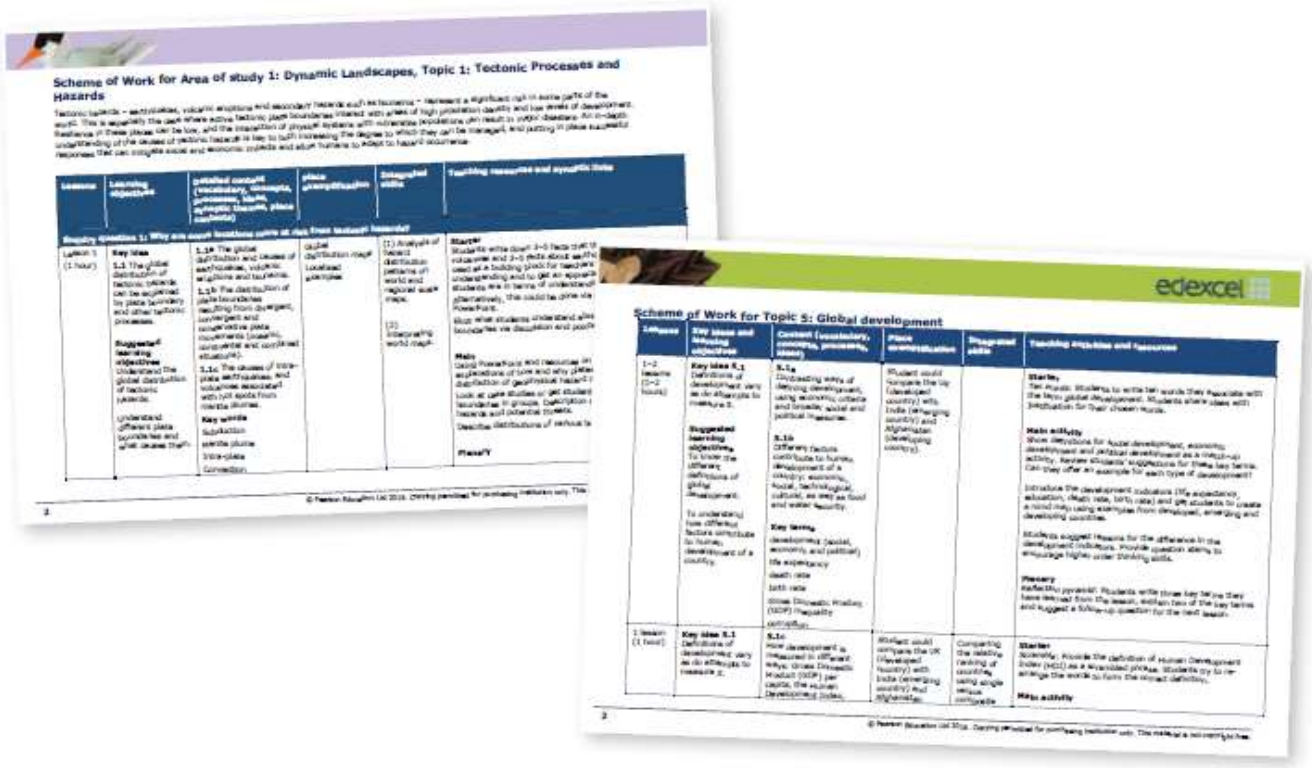
Schemes of Work for every topic



Scheme of Work for Area of study 1: Dynamic Landscapes, Topic 1: Tectonic Processes and Hazards

Scheme of Work for Topic 5: Global development

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Topic Booklets for every topic

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Guidance on teaching

The study of weather and climate, including the change in climate from the Ice Age to the present, is part of the statutory KS3 Geography curriculum. However, understanding climate change projections and global climate models can be difficult:

- Ask students to consider a single global atmospheric cell and think about the implications of combining different factors. Human factors are population growth, deforestation, policy direction and action, and the stage of industrial growth. Physical factors are Milankovitch cycles, sunspots, volcanoes, ice melting (with the associated feedback loops) and aerosols.
- Cross Roads Thinking (adapted from Mike Reetham's *Thinking Classroom*):
  - Ask students to pick two factors, e.g. population change and Milankovitch eccentricity, and write pairs of words to represent two extremes - e.g. 'population rise and population fall'
  - List the possible combinations and consider the implications for temperature or sea-level change: population rise and closest orbit, population rise and furthest orbit, population fall and closest orbit, population fall and furthest orbit
  - Finish by asking about the worst possible combination of factors as well as the best combination, therefore denoting the intermediate scenarios
  - This then links to the four different RCPs (2.6, 4.5, 6.0, 8.5).

Key vocabulary for EQ1

Global atmospheric and oceanic circulation	Natural climate change	Anthropogenic climate change
Heat budget Latitude Insolation Convection Condensation Equator High / low pressure Frontal rain Air circulation Desert Trade winds Hadley cell Ferrel cell Polar cell Mid-latitudes Air density Thermohaline circulation	Geological scale Fordings External Milankovitch Cycles Precession Eccentricity Tilt Quaternary Pleistocene Holocene Sunspot cycle Maunder minimum Little Ice Age Vostok Ice Core Roman Warm Period	Enhanced greenhouse effect Short-wave Long-wave Eustatic Thermal expansion Intergovernmental Panel on Climate Change (IPCC) Albedo Positive feedback Projections Representation Concentration Pathways (RCPs) Tropical cyclones Hurricanes Typhoons

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Key concepts and processes

The structure of a tropical cyclone can be taught through a step-by-step explanation of the physical processes:

- Warm oceanic water either side of the Equator begins to evaporate at the surface and air rises through convection, heavy with water vapour.
- This leaves a low pressure area at the surface of the water, which sucks in more air from the surroundings.
- As the air rises it begins to rotate, creating the eye wall, which is where the strongest winds are found.
- When the rising air reaches the top of the cyclone, the air flows away from the centre, leaving a layer of cirrus clouds that continue to spin.
- The air flowing away cools and sinks back to the ocean where the warm ocean water heats the air again, causing it to rise and continuing the cycle.
- The cyclical convection of warm, moist air results in bands of thunderstorm clouds on either side of the eyewall.
- Air that sinks within the eye wall results in high pressure at the centre of the cyclone where calm, cloudless skies are found, known as the eye of the storm.

Figure 4

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Session 1, 10:30 - 11:30am

What are Quantitative skills?

Richard Harris

School of Geographical Sciences
University of Bristol
rich.harris@bris.ac.uk

University of BRISTOL

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What are quantitative skills?

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- They are fundamental part of what it means to do geography and be a geographer

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What are quantitative skills?

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- They help us to explore and to explain geographical outcomes and processes

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What are quantitative skills not?

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- Limited to physical geography and primary data collection in the field

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What are quantitative skills not?

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- A pseudonym for statistical tests from the last century of uncertain relevance to non-random 'samples' of data ☺

$\chi^2 = 13.9$ ($p = 0.016$)

	# English LAs	% LAs	# greater share Leave	Expected number
Urban, major conurbation	75	23.0	33	56.8
Urban, minor conurbation	9	2.76	7	6.82
Urban with city/town	97	29.8	78	73.5
Urban with significant rural	54	16.6	46	40.9
Largely rural	41	12.6	36	31.1
Mainly rural	50	15.3	47	37.9
	326	100	247	247

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$\chi^2 = 13.9$ ($p = 0.016$)

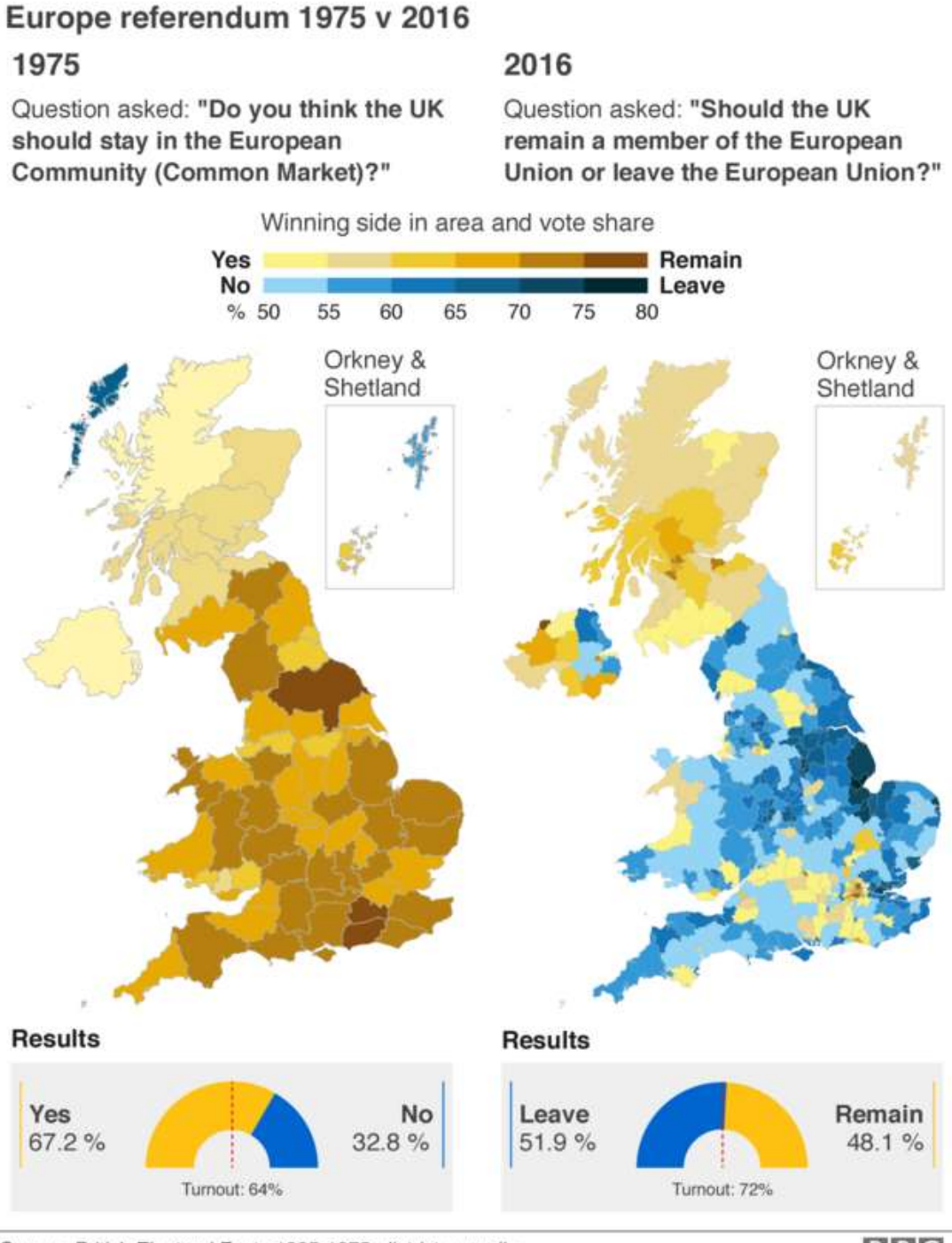
	# English LAs	% LAs	# greater share Leave	Expected number
Urban, major conurbation	75	23.0	33	56.8
Urban, minor	9	2.76	7	6.82
Largely rural	41	12.6	36	31.1
Mainly rural	50	15.3	47	37.9
	326	100	247	247

"Chi-square is something taught to geographers at school and misunderstood thereafter!" (Crawley, 2007)

Percentages are easier

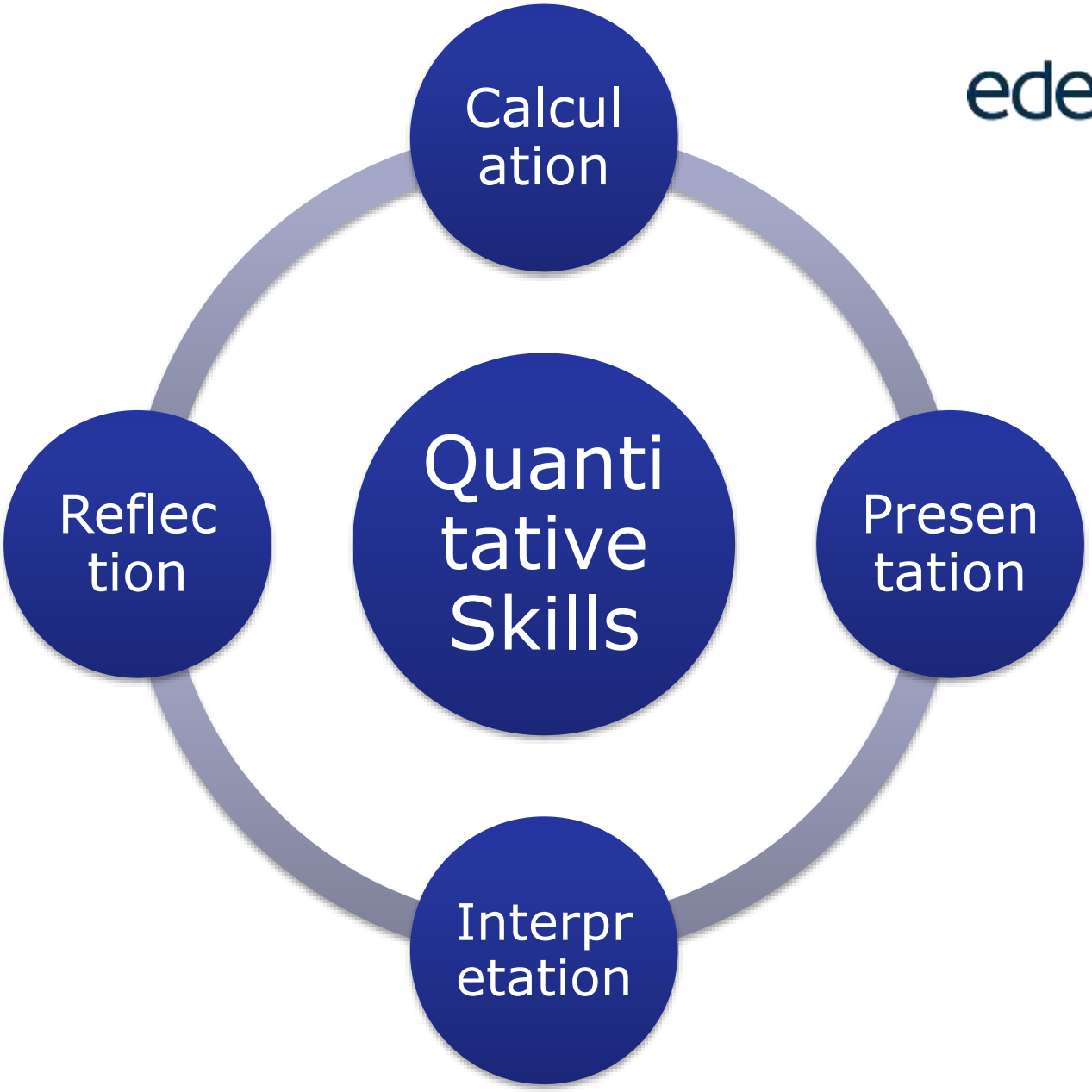
	# English LAs		# greater share Leave	% of group
Urban, major conurbation	75		33	44.0
Urban, minor conurbation	9		7	77.8
Urban with city/town	97		78	80.4
Urban with significant rural	54		46	85.2
Mainly rural	41		36	87.8
Largely rural	50		47	94.0
	326		247	

What are quantitative skills?



Source: http://www.bbc.co.uk/news/uk-politics-36616028

What are quantitative skills?



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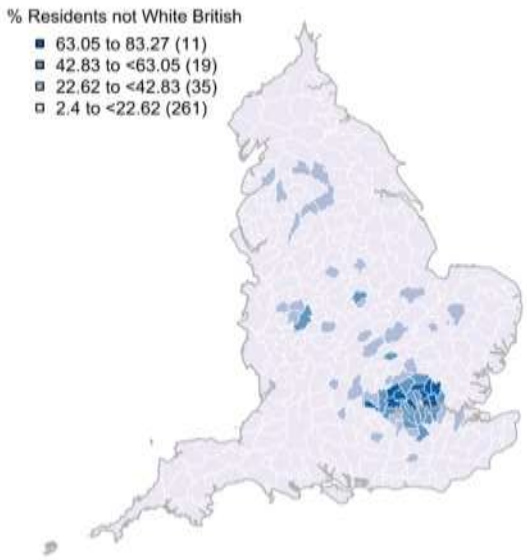
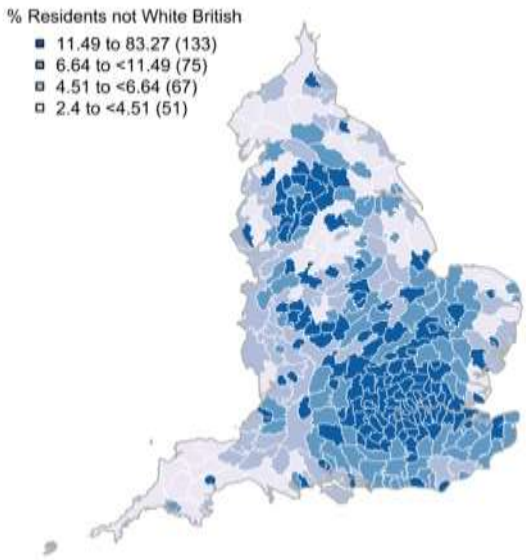
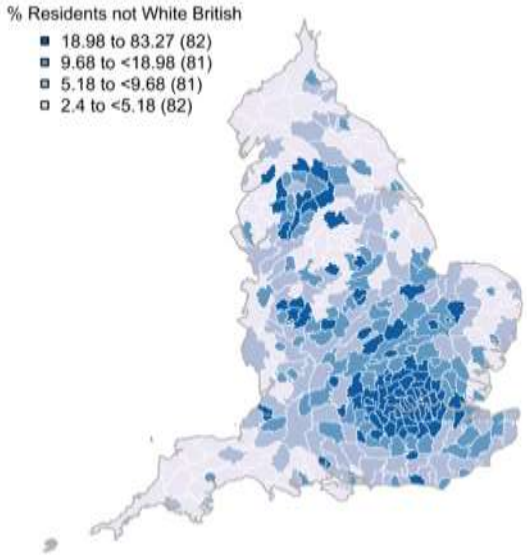
(a) Equal interval classification



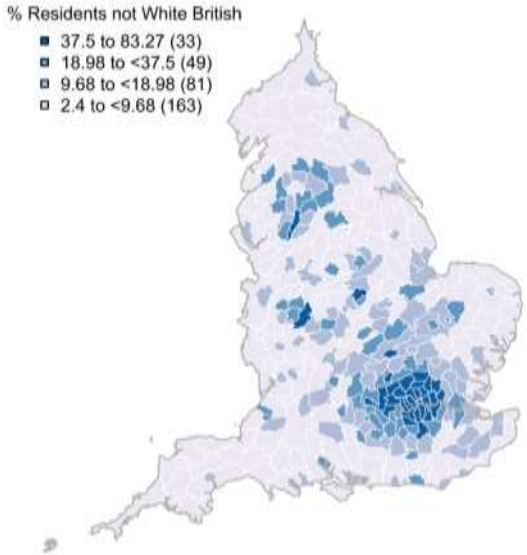
(b) Equal area classification



(c) Quantile classification



(d) Manual classification



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Which of these maps is correct?

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$$(A.1)\quad \ln(T_{ijt}) = \alpha_{ij} + \gamma_t + \alpha_1 \ln(Y_{it} * Y_{jt}) + \alpha_2 \ln(POP_{it} * POP_{jt}) + \alpha_3 \ln(DIST_{ij}) + \alpha_4 COMLANG_{ij} + \alpha_5 COLONY_{ij} + \alpha_6 BORDER_{ij} + \varepsilon_{ijt} = \alpha_{ij} + \gamma_t + \alpha X_{ijt} + \varepsilon_{ijt}$$

$$(A.2)\quad \ln(T_{ijt}) = \alpha_{ij} + \gamma_t + \alpha_1 \ln(Y_{it} * Y_{jt}) + \alpha_2 \ln(POP_{it} * POP_{jt}) + \varepsilon_{ijt} = \alpha_{ij} + \gamma_t + \alpha X_{ijt} + \varepsilon_{ijt}$$

$$(A.3)\quad \ln(T_{ijt}) = \alpha_{ij} + \alpha X_{ijt} + \beta_1 EU2_{ijt} + \beta_2 EU1_{ijt} + \beta_3 EEA_{ijt} + \beta_4 FTA_{ijt} + \varepsilon_{ijt}$$

$$(A.4)\quad x_{ij} = \frac{y_i y_j}{y^w} \left(\frac{t_{ij}}{P_i P_j} \right)^{1-\sigma}$$

$$\ln(T_{ijt}) = \alpha X_{ijt} + \beta_1 NTB_{ijt} + \beta_2 Tariff_{ijt} + \varepsilon_{ijt}$$

$$(A.5)\quad \ln(IFDI_{ijt}) = \alpha_{ij} + \alpha_1 \ln(Y_{it}) + \alpha_2 \ln(Y_{jt}) + \alpha_3 \ln(DIST_{ij}) + \alpha_4 POP_{it} + \alpha_5 POP_{jt} + \alpha_6 COMLANG_{ij} + \alpha_7 COLONY_{ij} + \alpha_8 BORDER_{ij} + \alpha_9 EMU2_{ijt} + \alpha_{10} EMU1_{ijt} + \varepsilon_{ijt} = \alpha_{ij} + \alpha X_{ijt} + \varepsilon_{ijt}$$

$$(A.6)\quad \ln(IFDI_{ijt}) = \alpha_{ij} + \alpha_1 \ln(Y_{jt}) + \alpha_2 \ln(Y_{it}) + \alpha_3 POP_{it} + \alpha_4 POP_{jt} + \alpha_5 EMU2_{ijt} + \alpha_6 EMU1_{ijt} + \varepsilon_{ijt} = \alpha_{ij} + \alpha X_{ijt} + \varepsilon_{ijt}$$

$$(A.7)\quad \ln(IFDI_{ijt}) = \alpha_{ij} + \alpha X_{ijt} + \beta_1 EU2_{ijt} + \beta_2 EUm_{ijt} + \beta_3 FTA_t + \varepsilon_{ijt}$$

Demystifying!

http://www.independent.co.uk/news/business/analysis-and-features/does-the-treasurys-brexit-equation-stand-up-to-scrutiny-a6989356.html

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- And it's easier than it's often portrayed
- 'Cheap geography', see http://www.rgs.org/NR/rdonlyres/9A5CB6C8-CDE5-47AA-9577-0C7FA7765987/0/WhytheFutureofGeographyisCheap.pdf

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What are quantitative skills?

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- Telling stories with data…

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What are quantitative skills?

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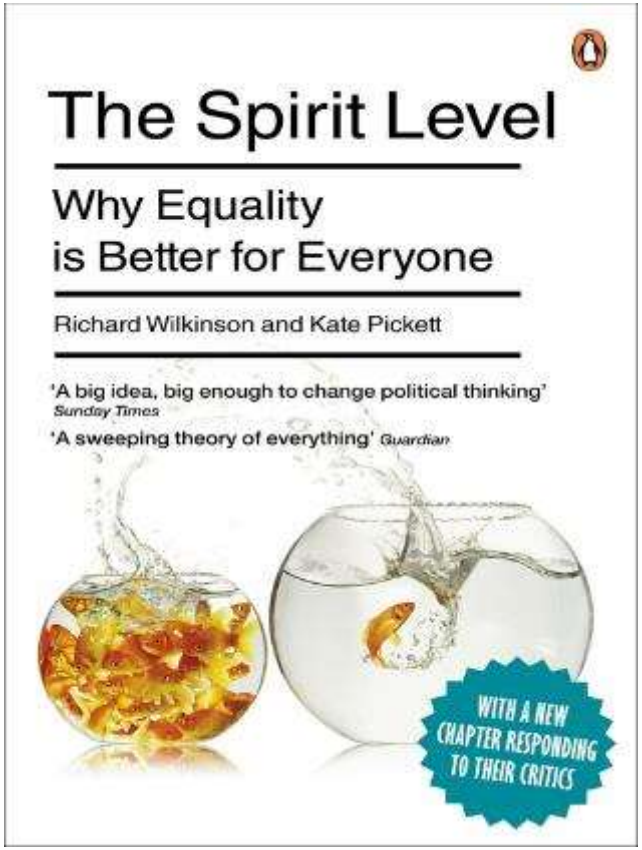
- But some stories are better told than others

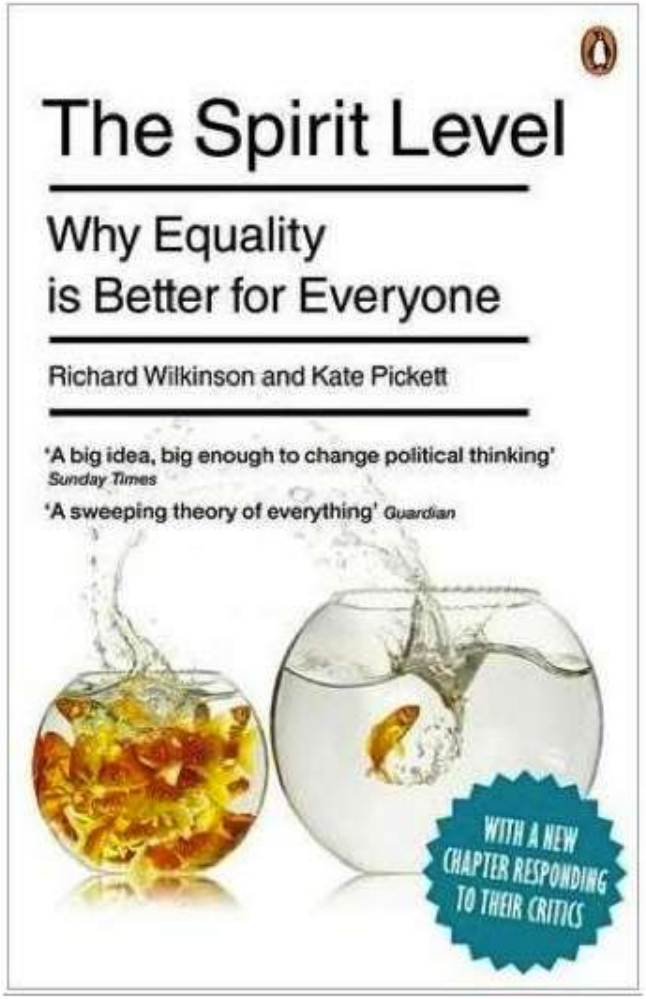
For example


The Spirit Level
Why Equality is Better for Everyone
Richard Wilkinson and Kate Pickett
'A big idea, big enough to change political thinking' Sunday Times
'A sweeping theory of everything' Guardian
WITH A NEW CHAPTER RESPONDING TO THEIR CRITICS


THE DIVIDE

Introduction

- This PowerPoint file contains 35 of the more important graphs shown on The Equality Trust website at www.equalitytrust.org.uk
- The graphs are also published in the book by Richard Wilkinson and Kate Pickett, *The Spirit Level: Why Equality is Better for Everyone* (Penguin, 2010).
- We hope you will use them in talks, lectures or discussion groups to help increase people's understanding of the effects of inequality.
- These slides are provided on condition that you acknowledge their source.
- We strongly recommend that you use them in conjunction with the book, which explains the relationships shown in the graphs.



Donations

The Equality Trust is working hard to build a better society, by gaining a wider public understanding of the damaging effects of large inequalities of income and wealth. Together we can build support for policies to reduce them.

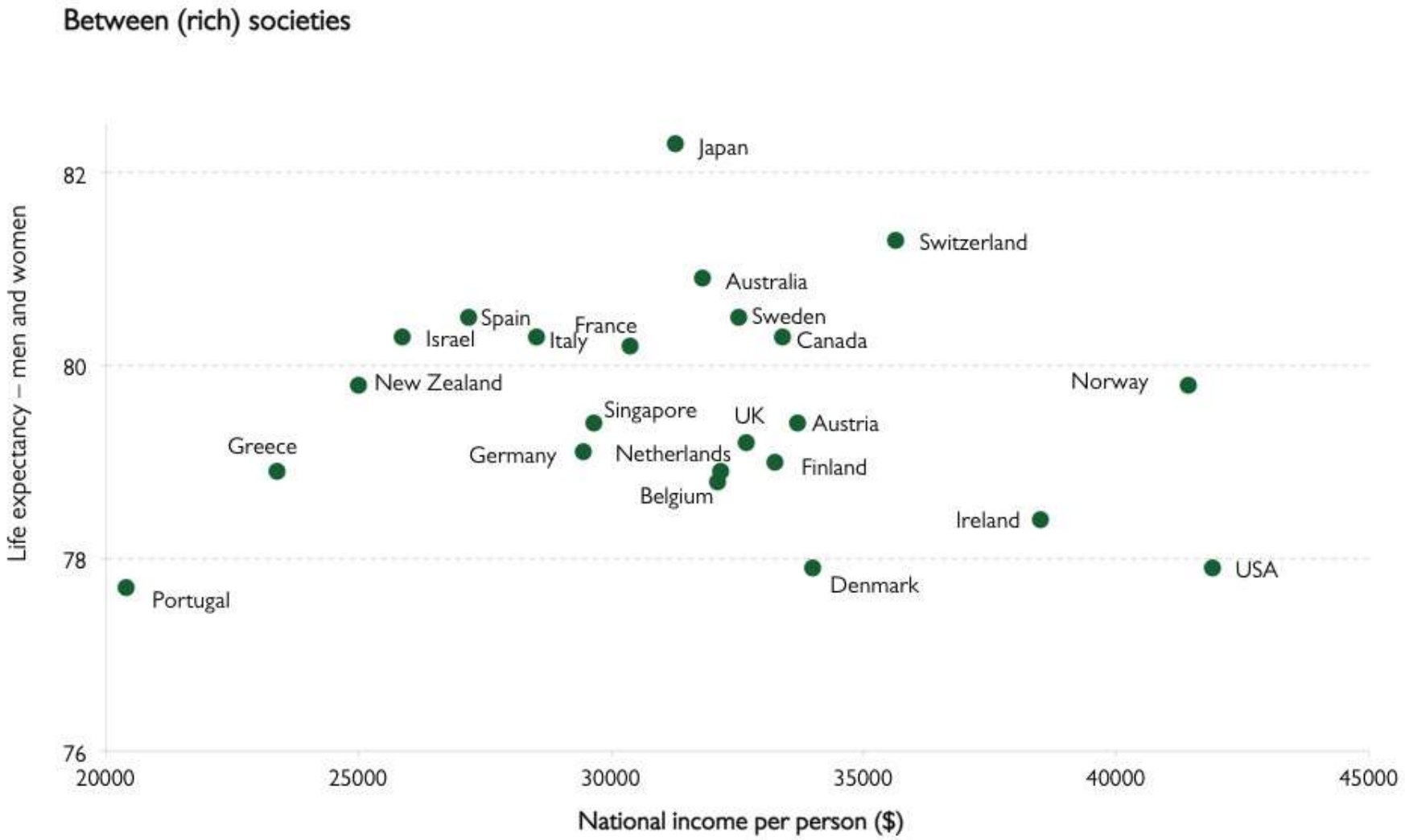
As these slides represent many years of work and thought, we would be very grateful for donations to help The Equality Trust continue its work.

As an independent, not-for-profit organisation, our work depends on generous donations from individuals and trusts which share our vision.

You can donate in two ways:

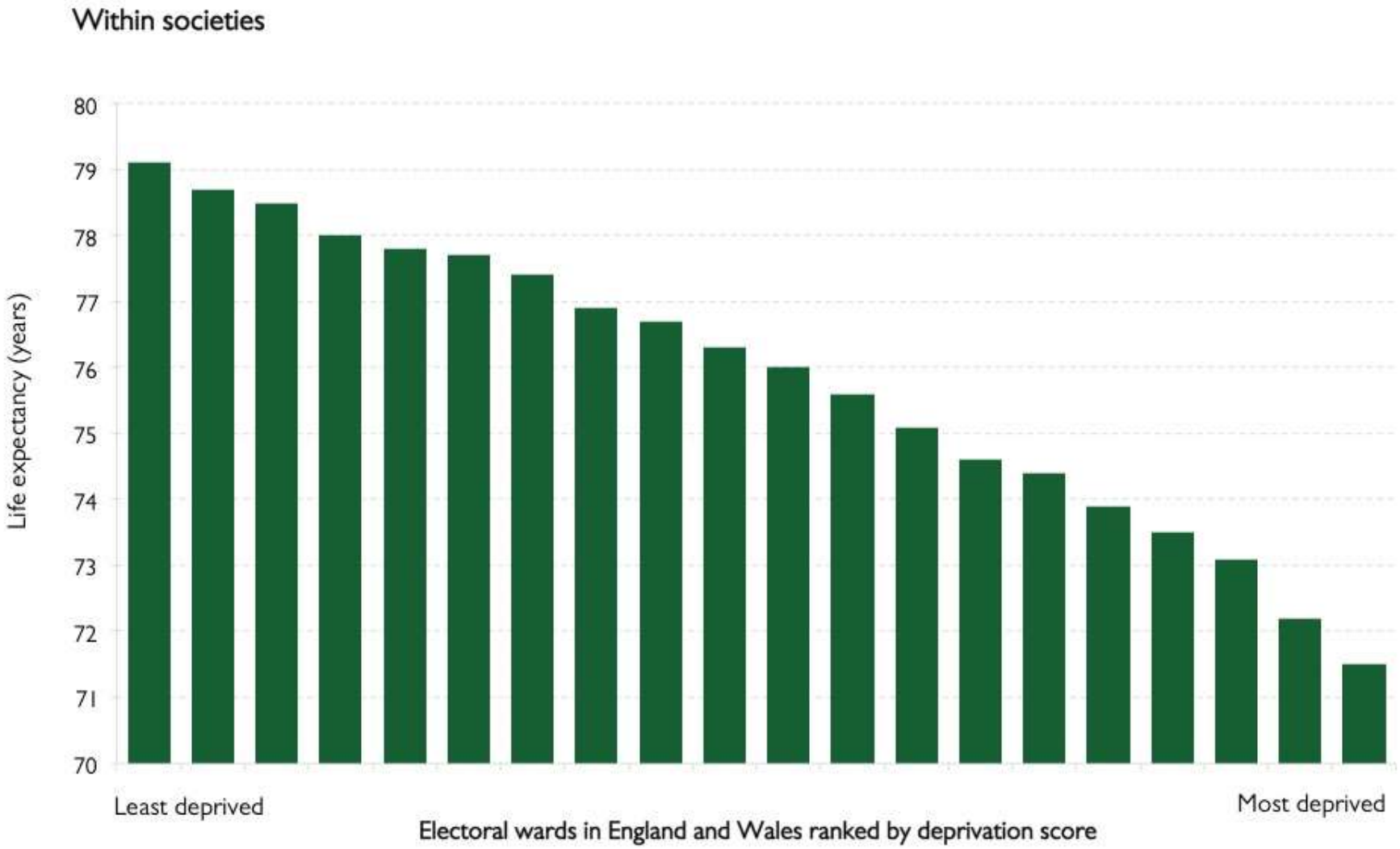
- Use PayPal to donate online at **www.equalitytrust.org.uk**
- Send a cheque payable to **The Equality Trust, 32-36 Loman Street, London SE1 0EH, UK**

Health is related to income differences *within* rich societies but not to those *between* them



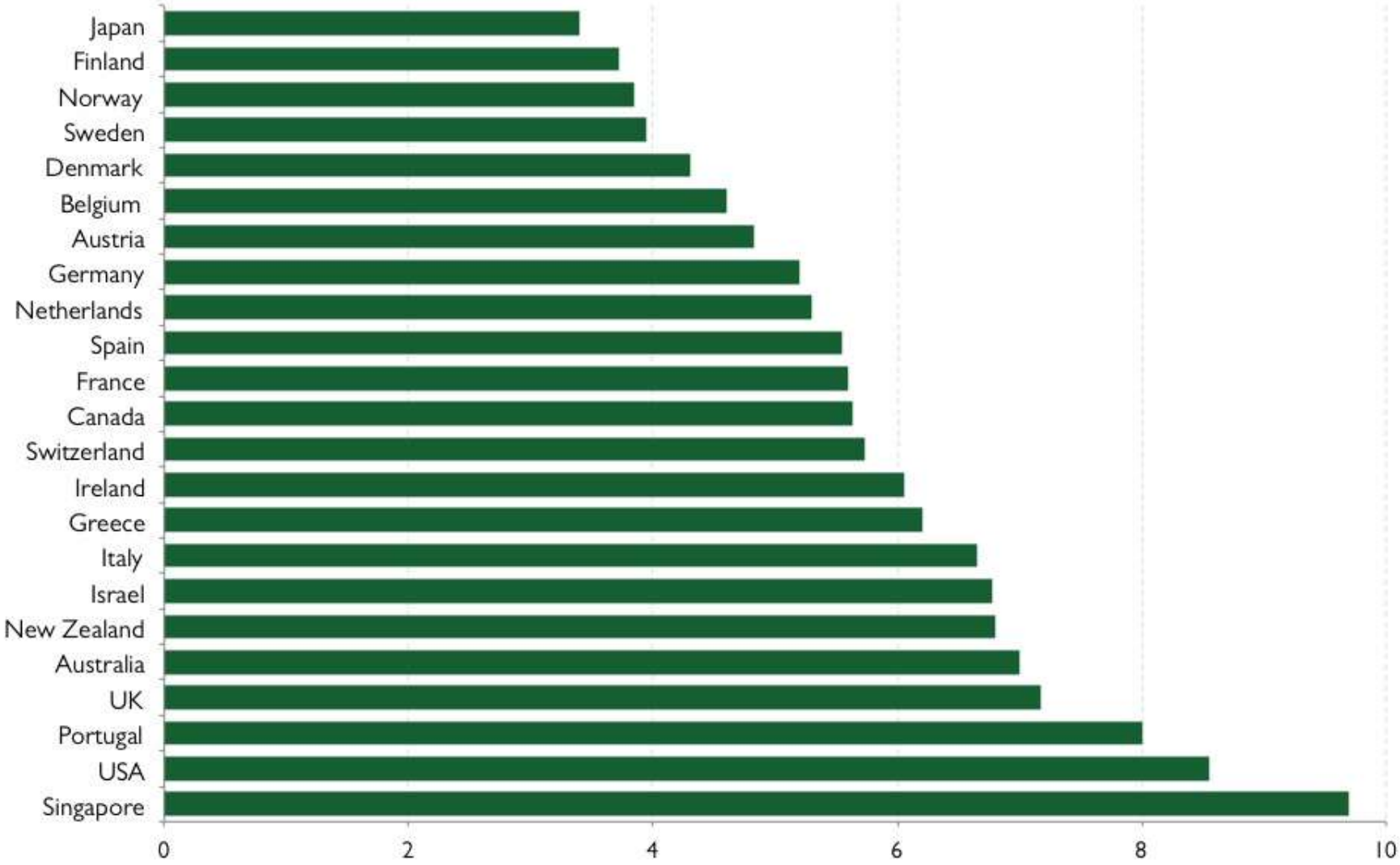
Source: Wilkinson & Pickett, The Spirit Level (2009)

Health is related to income differences *within* rich societies but not to those *between* them



Source: Wilkinson & Pickett, The Spirit Level (2009)

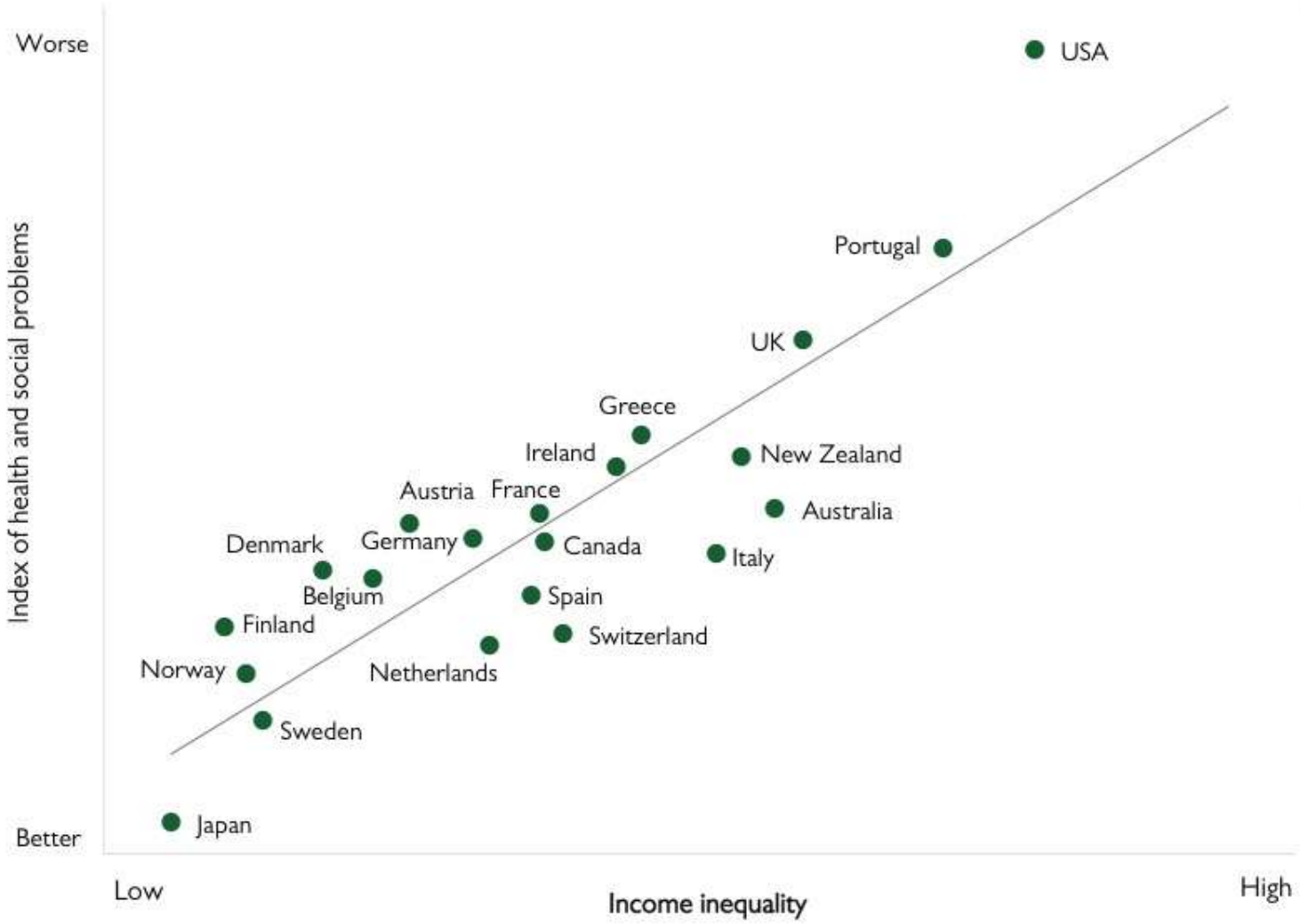
How much richer are the richest 20% than the poorest 20%?



Source: Wilkinson & Pickett, The Spirit Level (2009) / United Nations Development Program

THE EQUALITY TRUST

Health and social problems are worse in more unequal countries

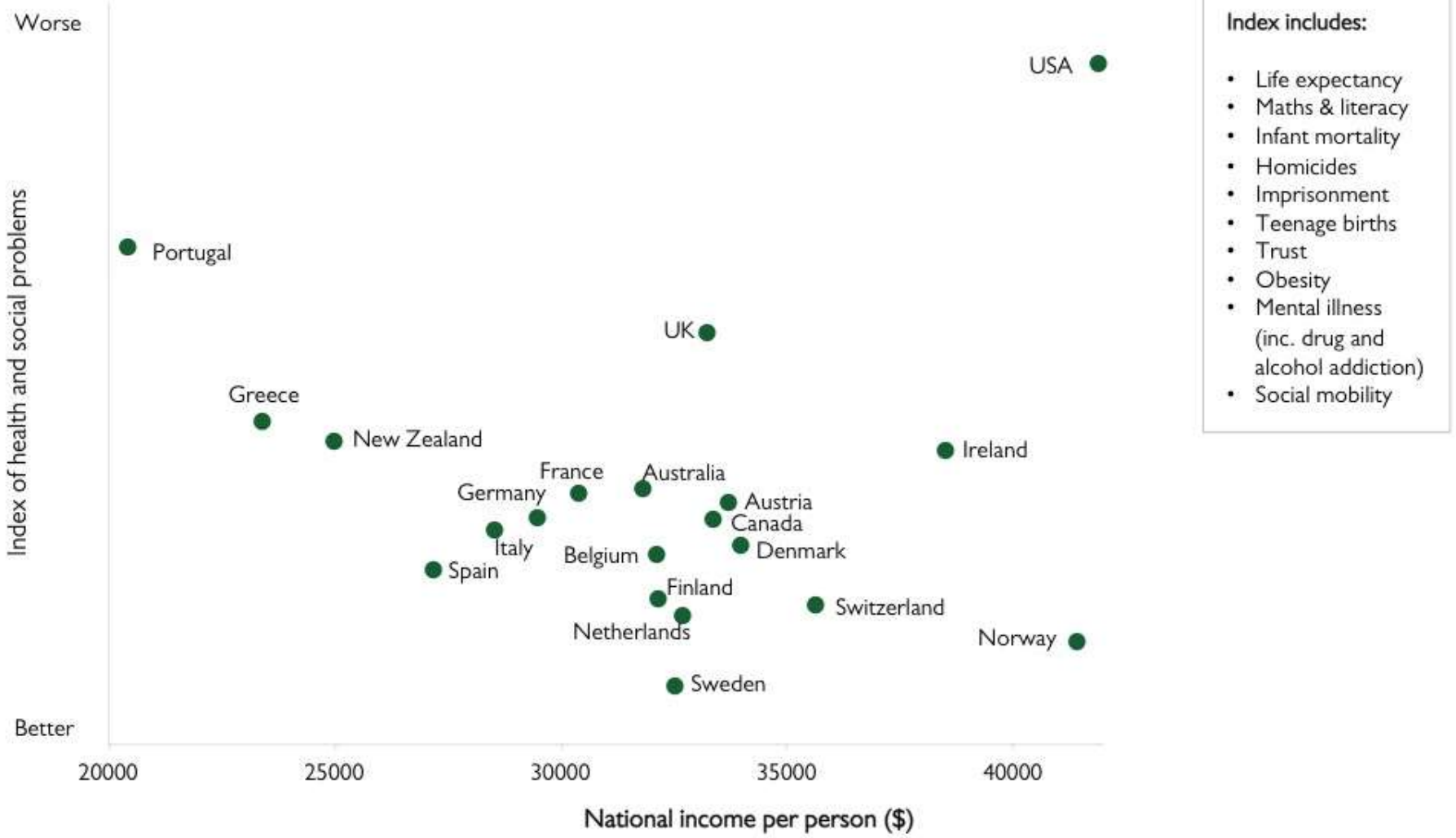


Index includes:

- Life expectancy
- Maths & literacy
- Infant mortality
- Homicides
- Imprisonment
- Teenage births
- Trust
- Obesity
- Mental illness (inc. drug and alcohol addiction)
- Social mobility

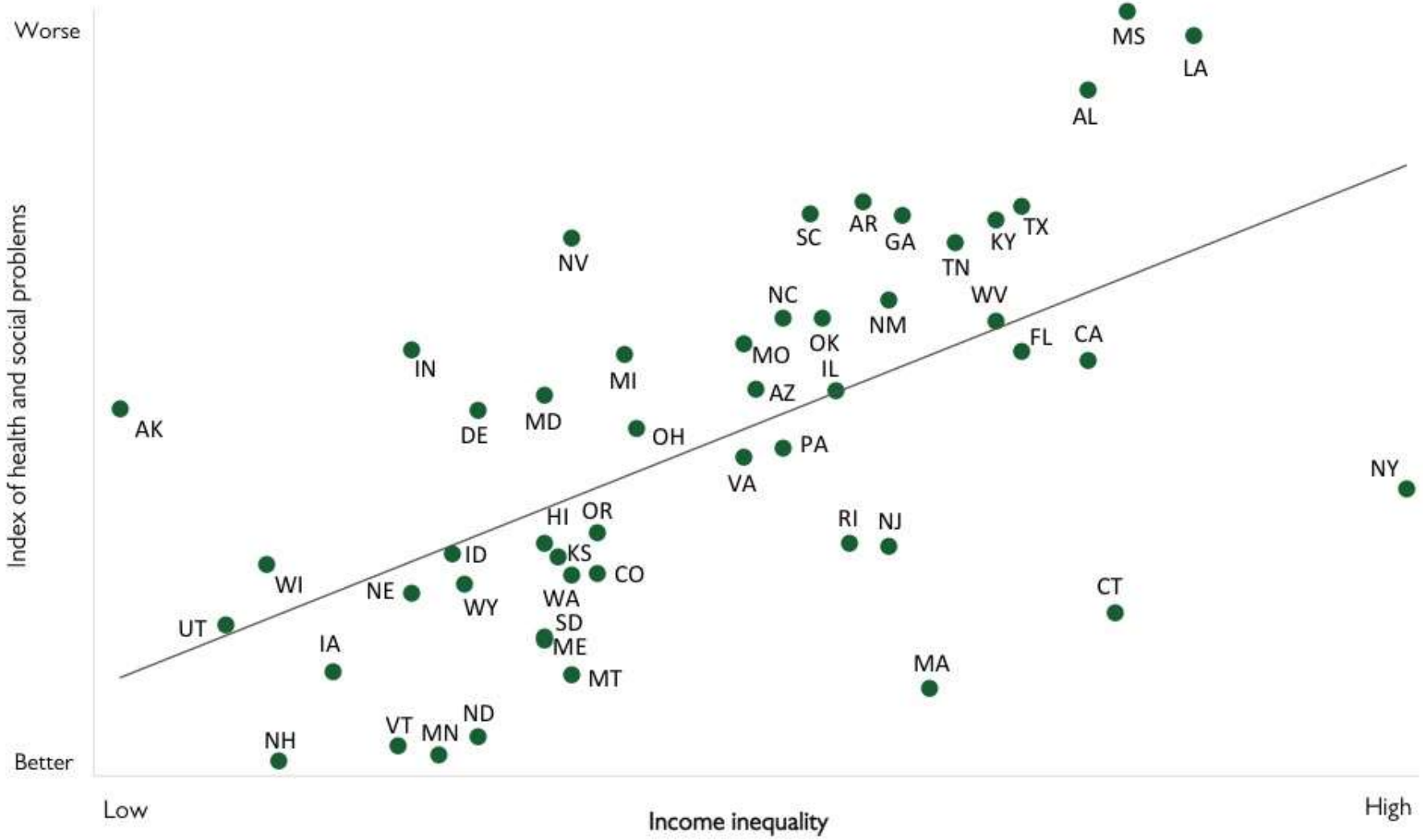
Source: Wilkinson & Pickett, The Spirit Level (2009)

Health and social problems are not related to average income in rich countries



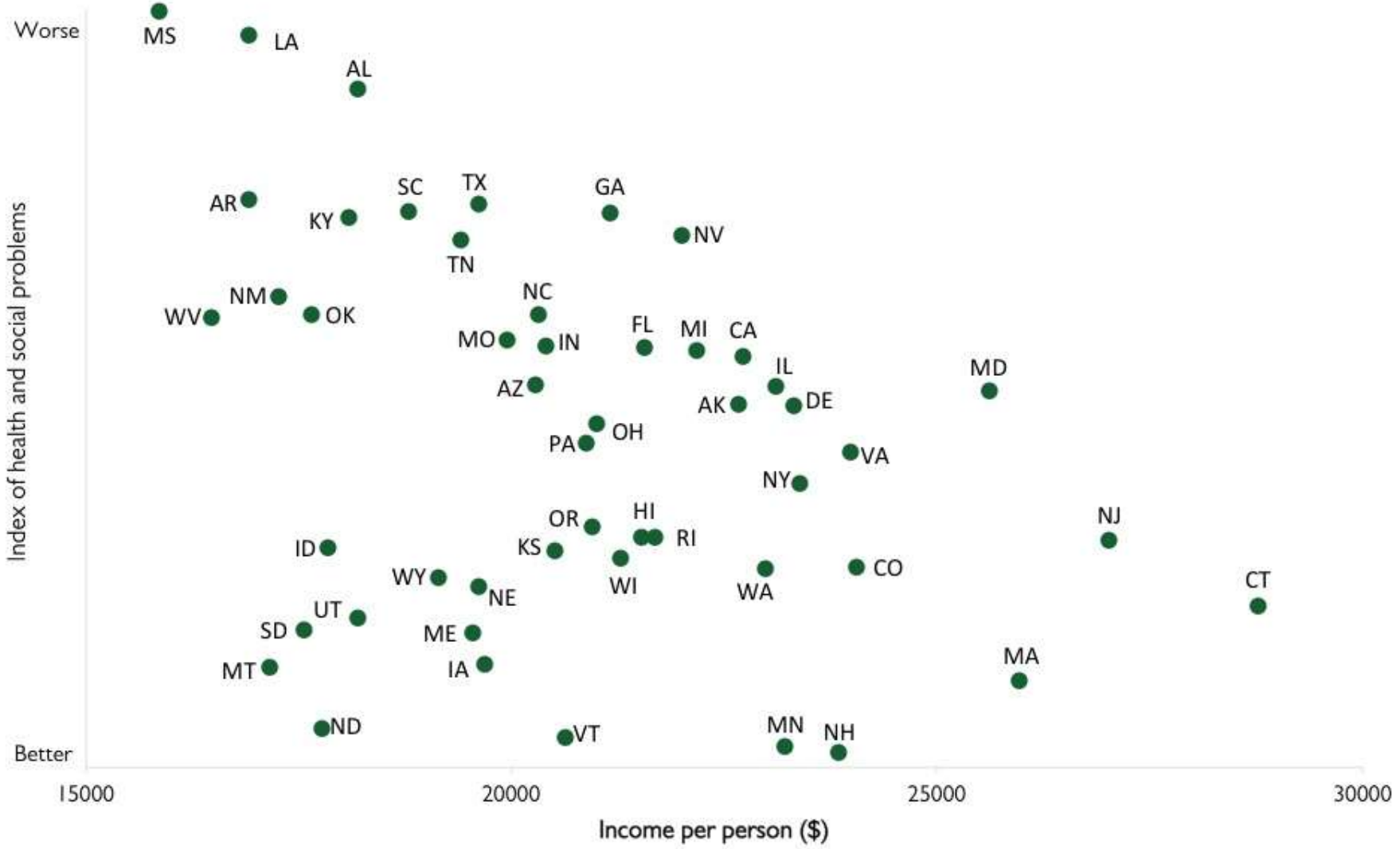
Source: Wilkinson & Pickett, The Spirit Level (2009)

Health and social problems are worse in more unequal US states



Source: Wilkinson & Pickett, The Spirit Level (2009)

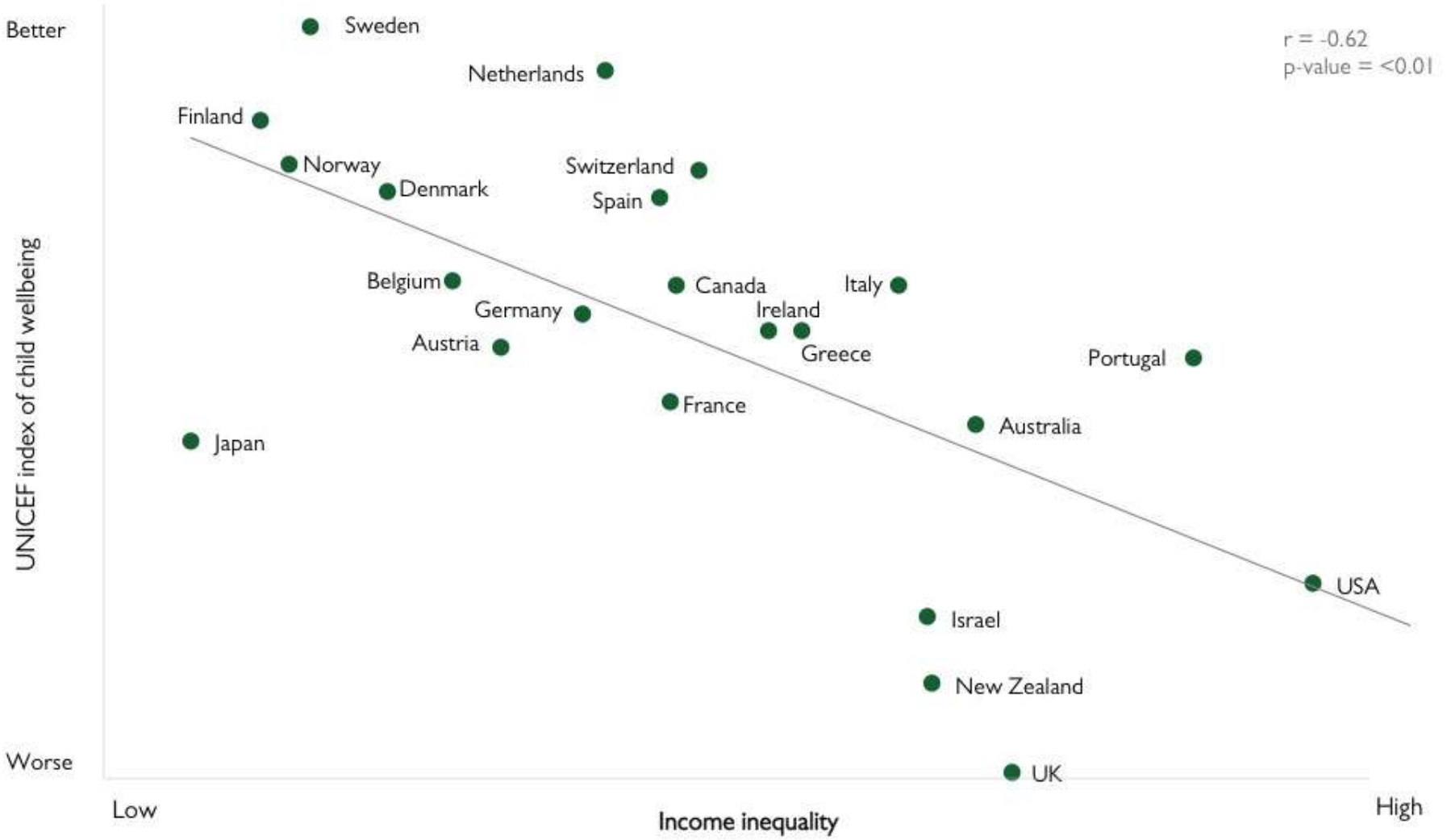
Health and social problems are only weakly related to average income in US states



Source: Wilkinson & Pickett, The Spirit Level (2009)

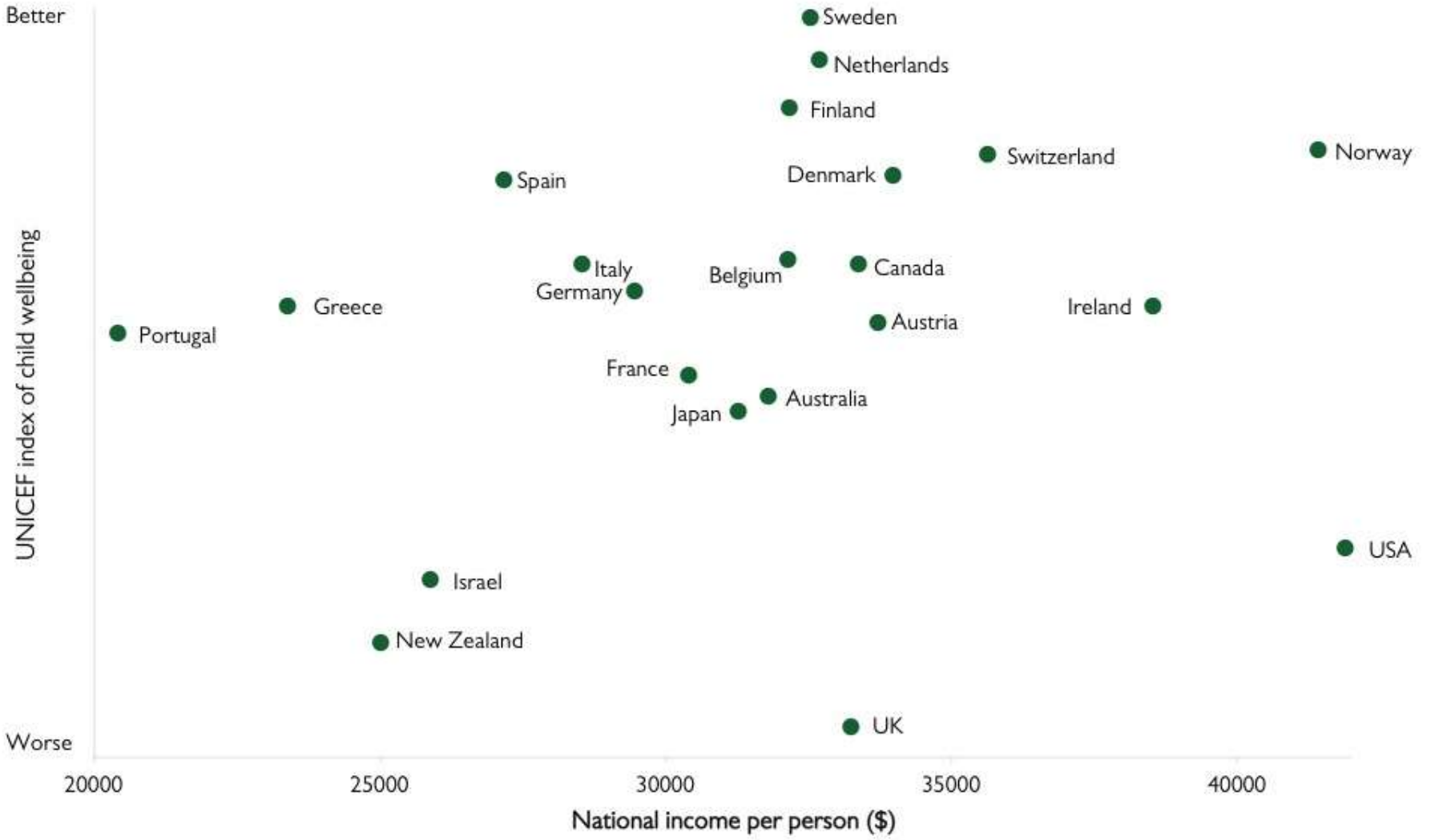
THE EQUALITY TRUST

Child wellbeing is better in more equal rich countries



Source: Wilkinson & Pickett, The Spirit Level (2009)

Child wellbeing is unrelated to average incomes in rich countries



Source: Wilkinson & Pickett, The Spirit Level (2009)

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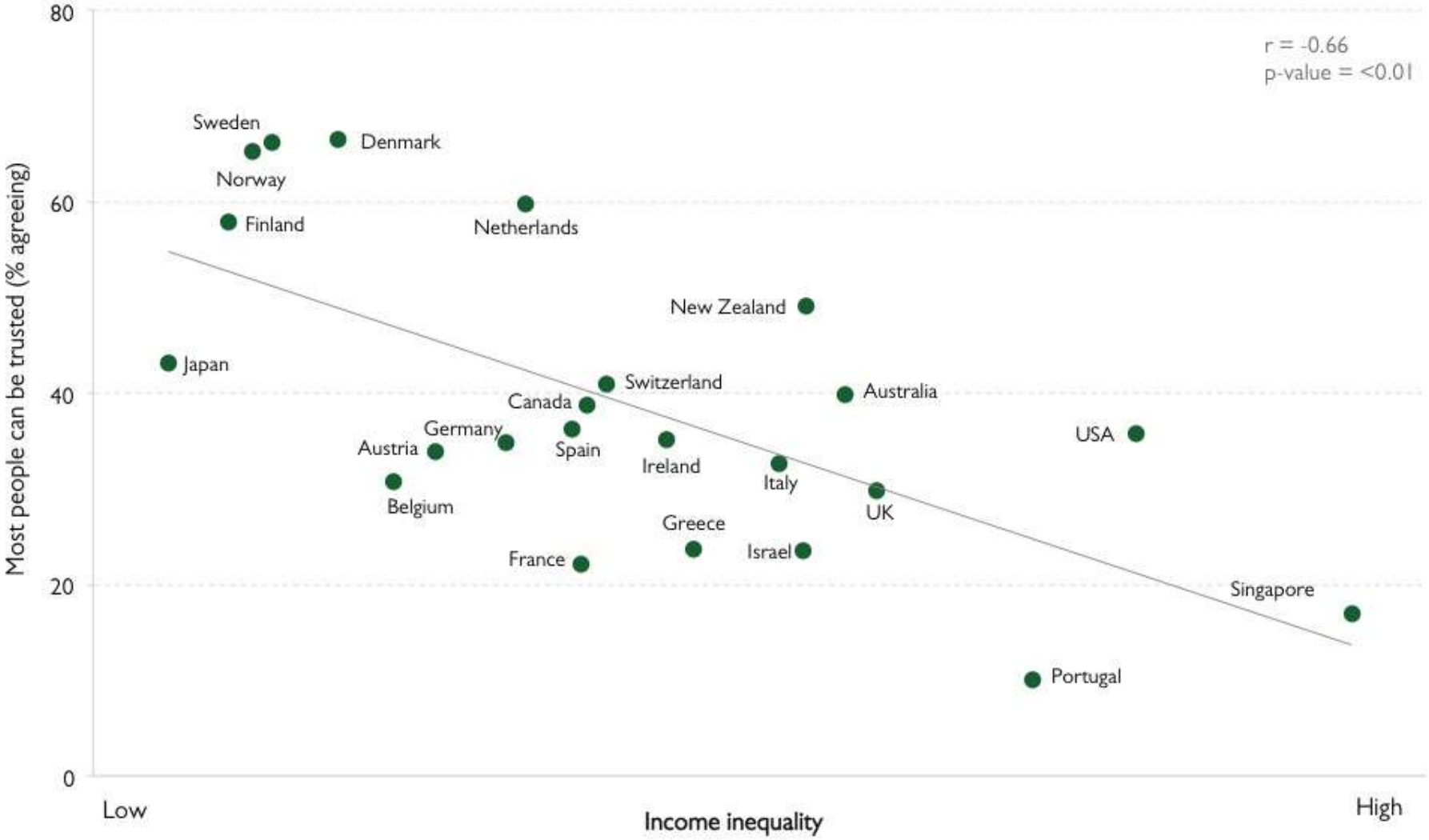
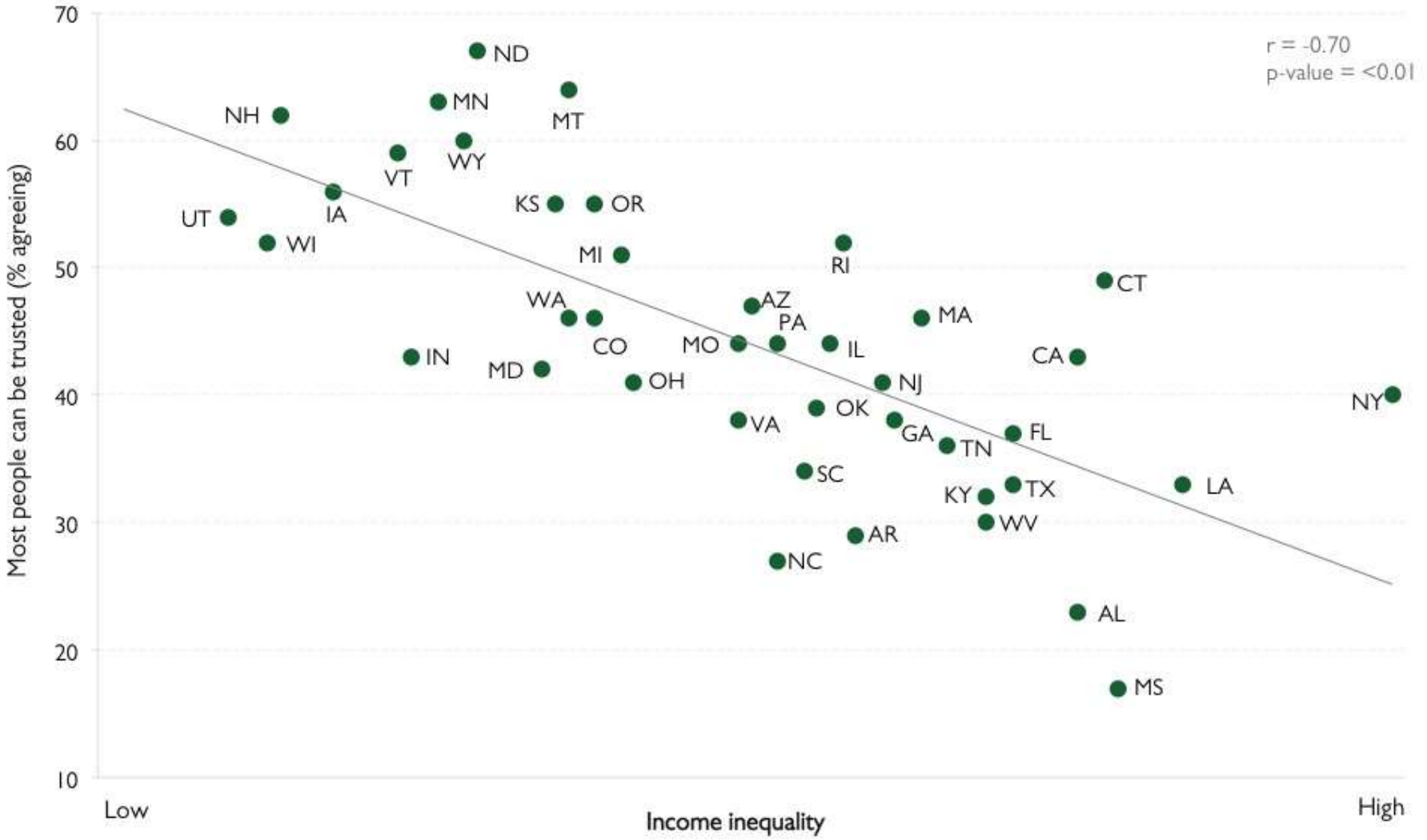
Levels of trust are higher in more equal rich countries



Source: Wilkinson & Pickett, The Spirit Level (2009)

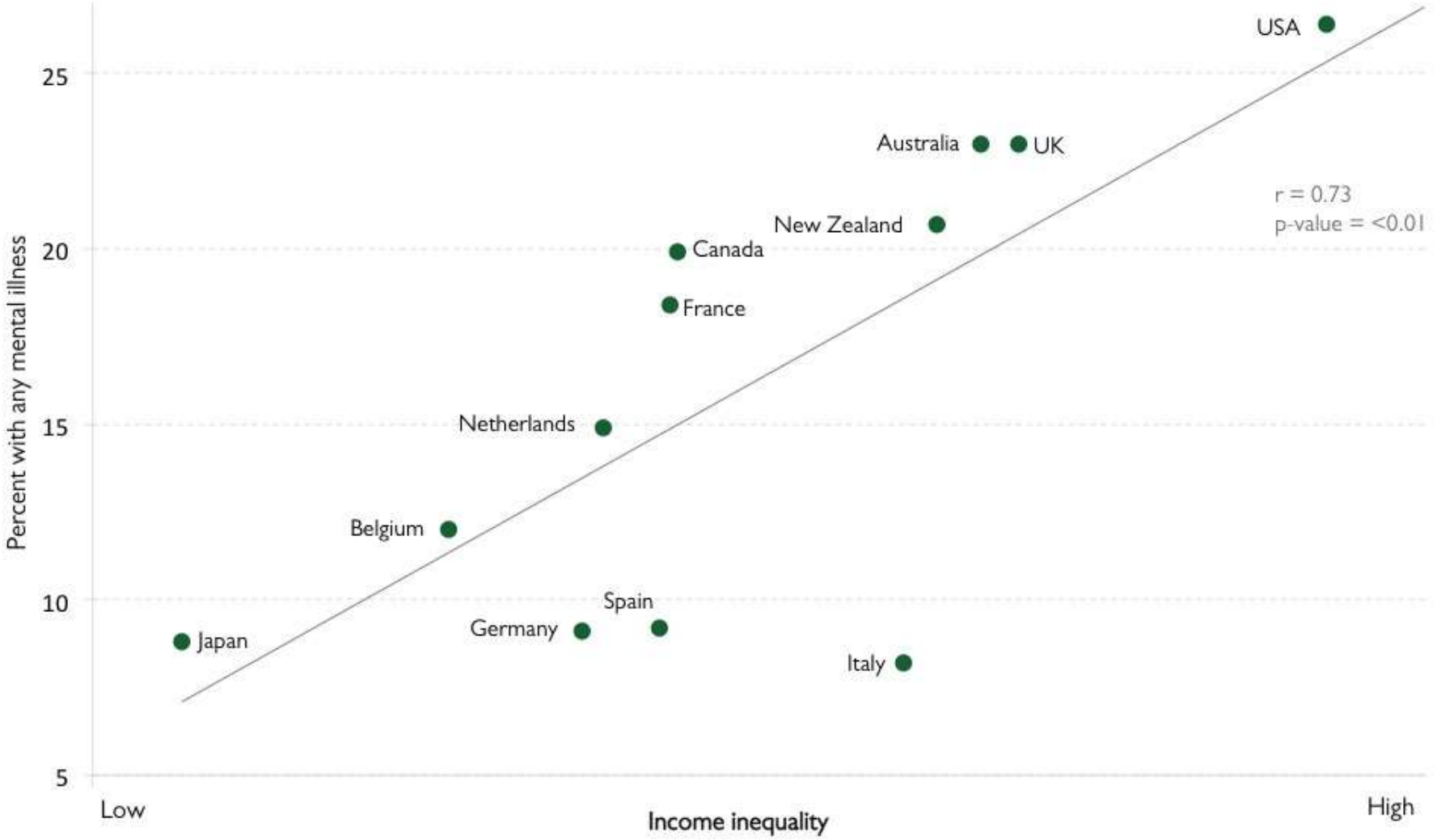
Levels of trust are higher in more equal US states



Source: Wilkinson & Pickett, The Spirit Level (2009)

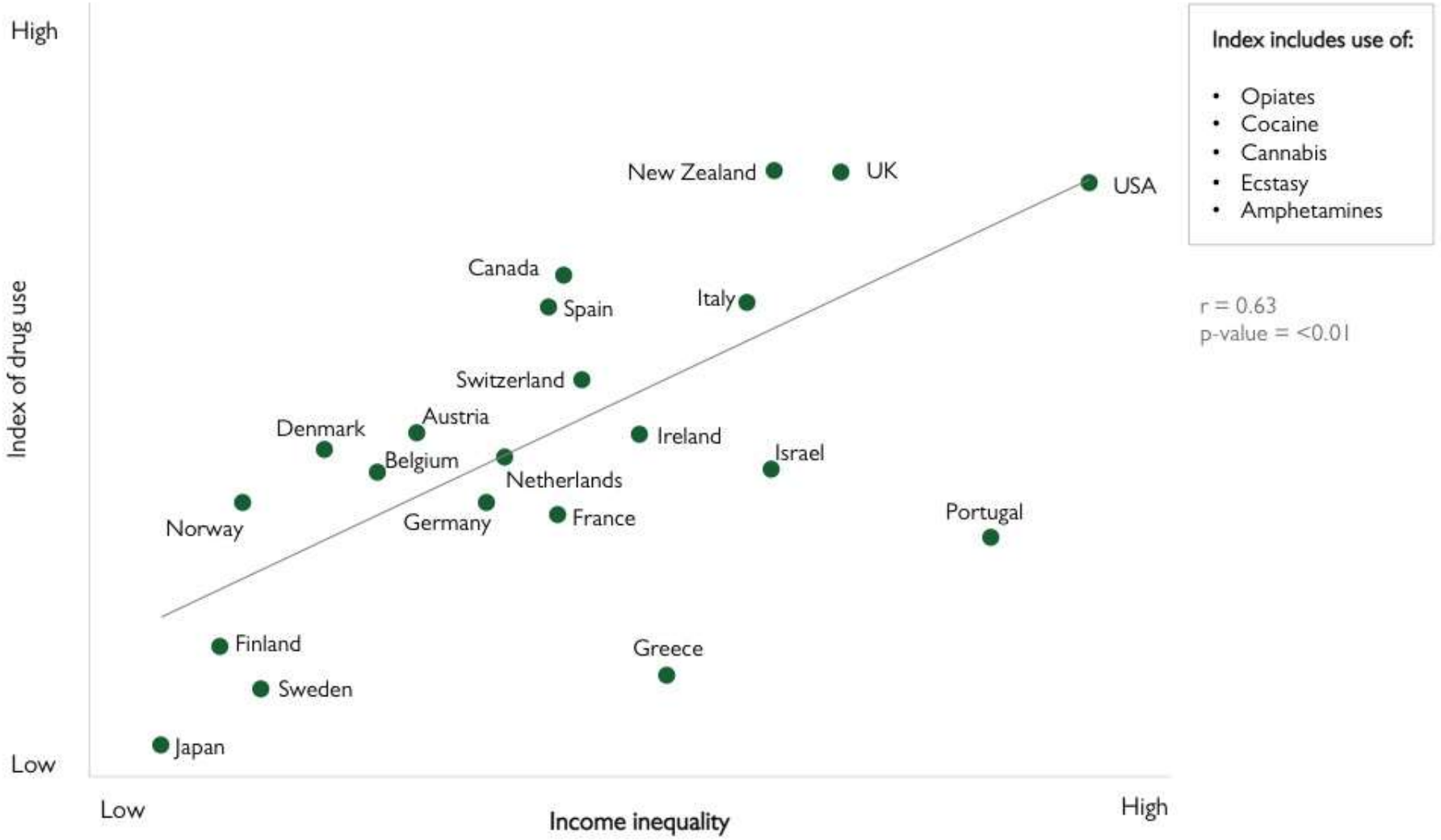
THE EQUALITY TRUST

The prevalence of mental illness is higher in more unequal rich countries



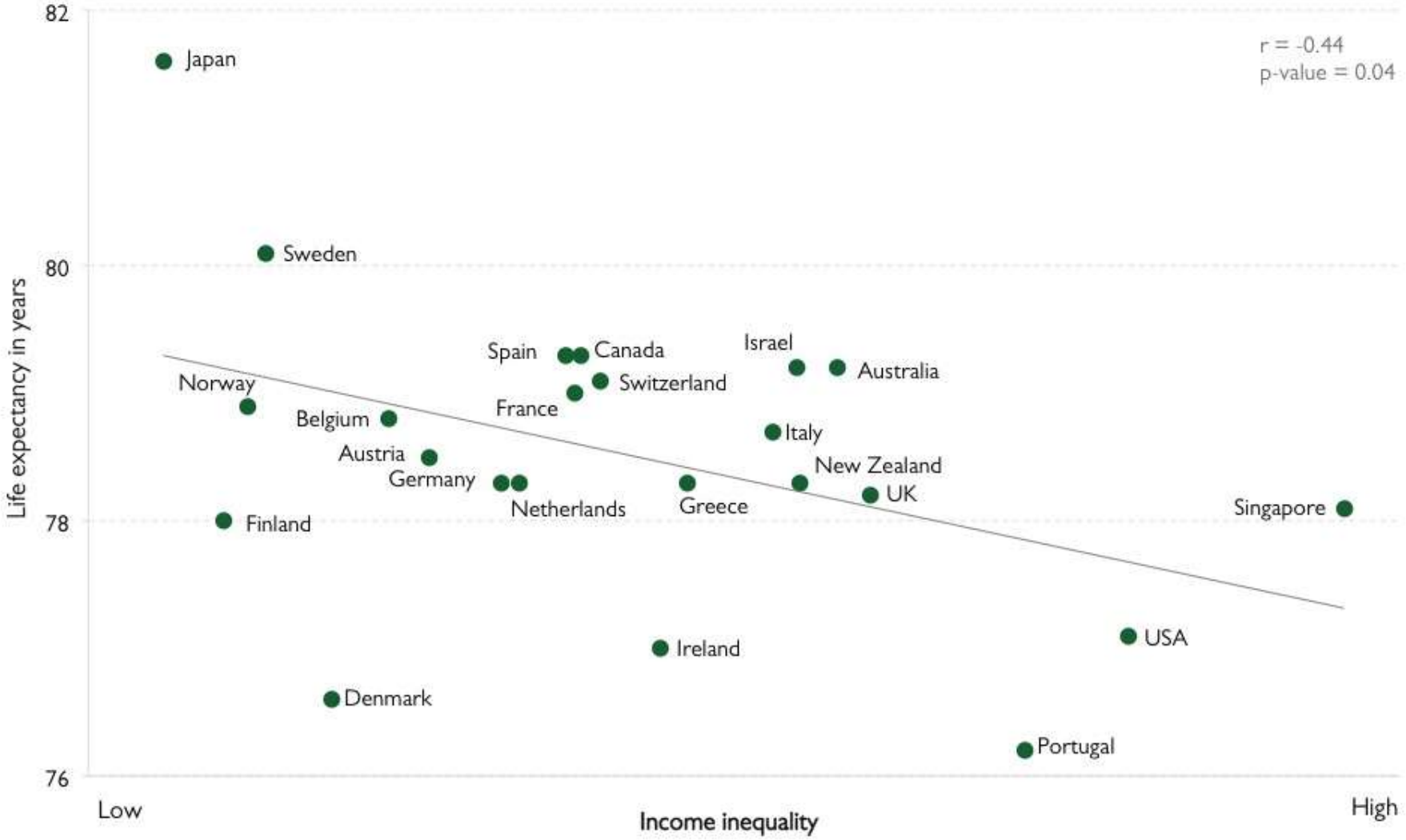
Source: Wilkinson & Pickett, The Spirit Level (2009)

Drug use is more common in more unequal countries



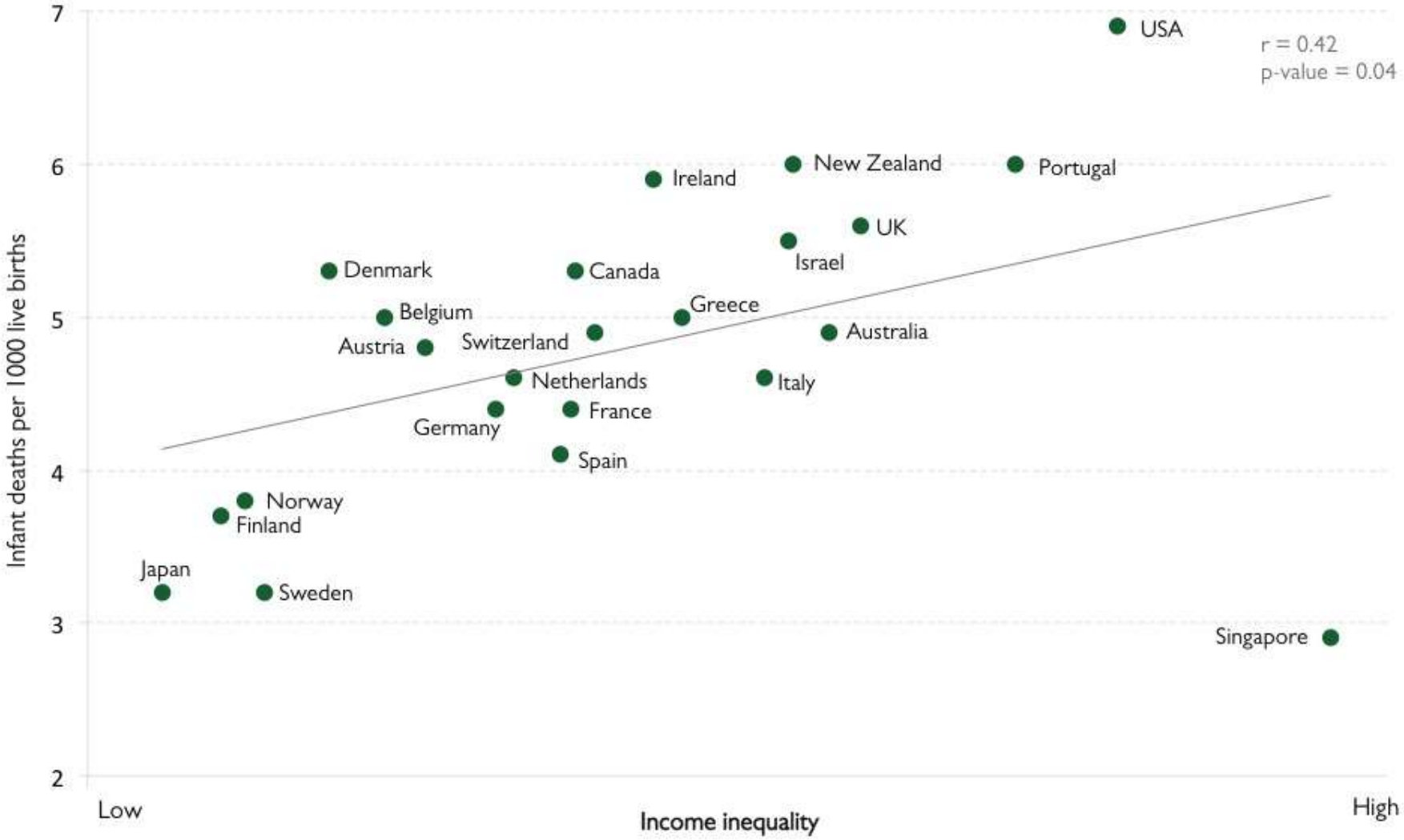
Source: Wilkinson & Pickett, The Spirit Level (2009)

Life expectancy is longer in more equal rich countries



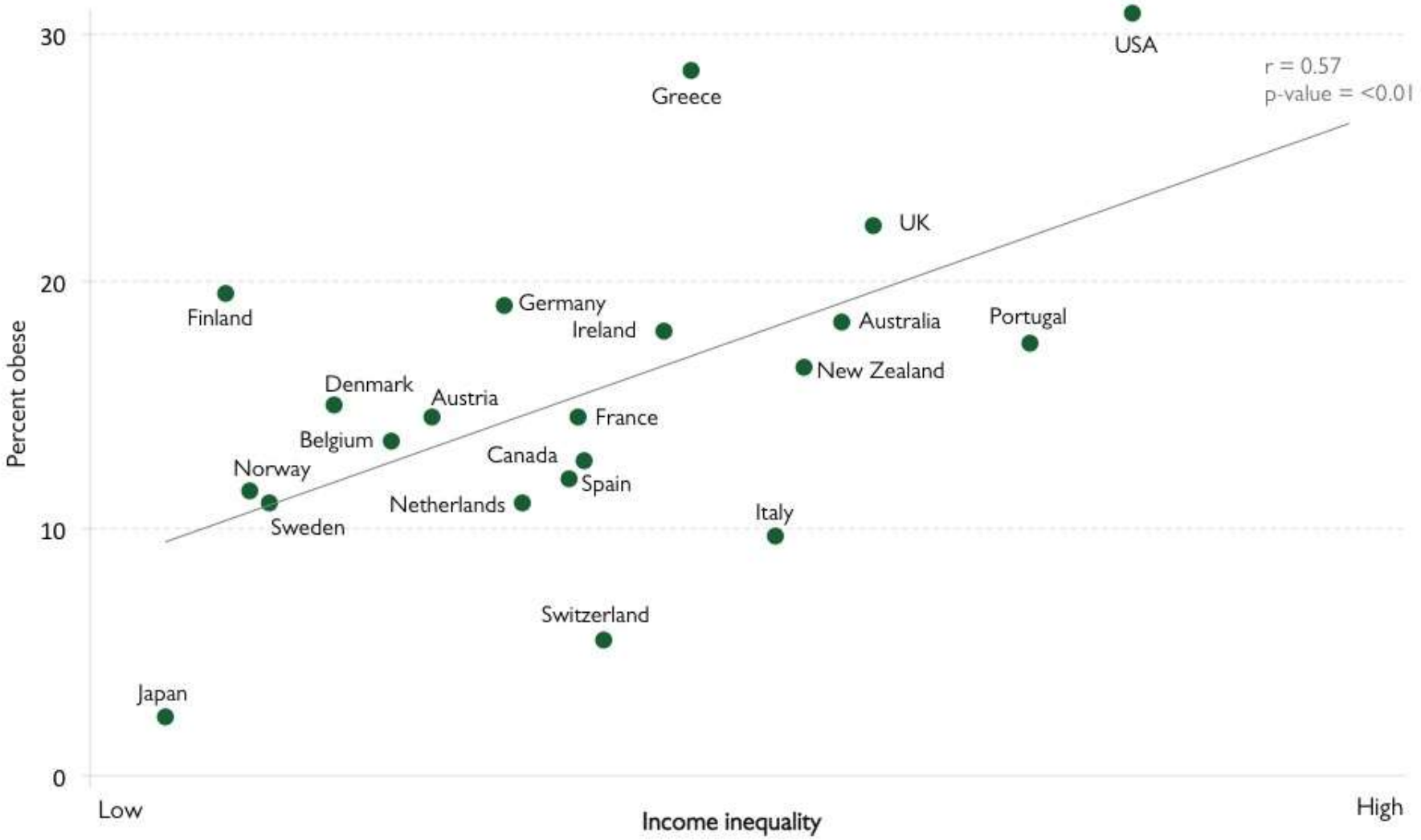
Source: Wilkinson & Pickett, The Spirit Level (2009)

Infant mortality rates are higher in more unequal countries



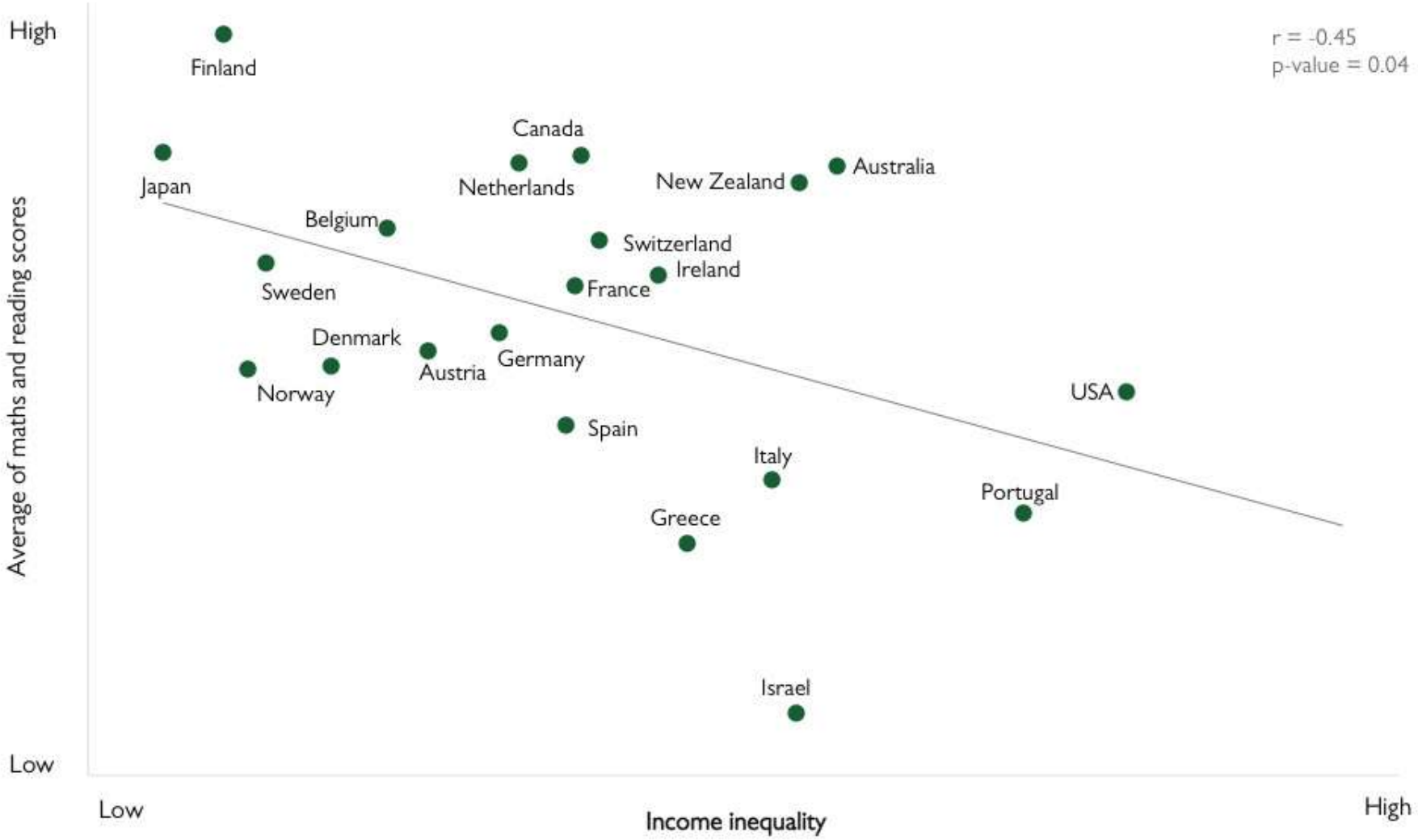
Source: Wilkinson & Pickett, The Spirit Level (2009)

More adults are obese in more unequal rich countries



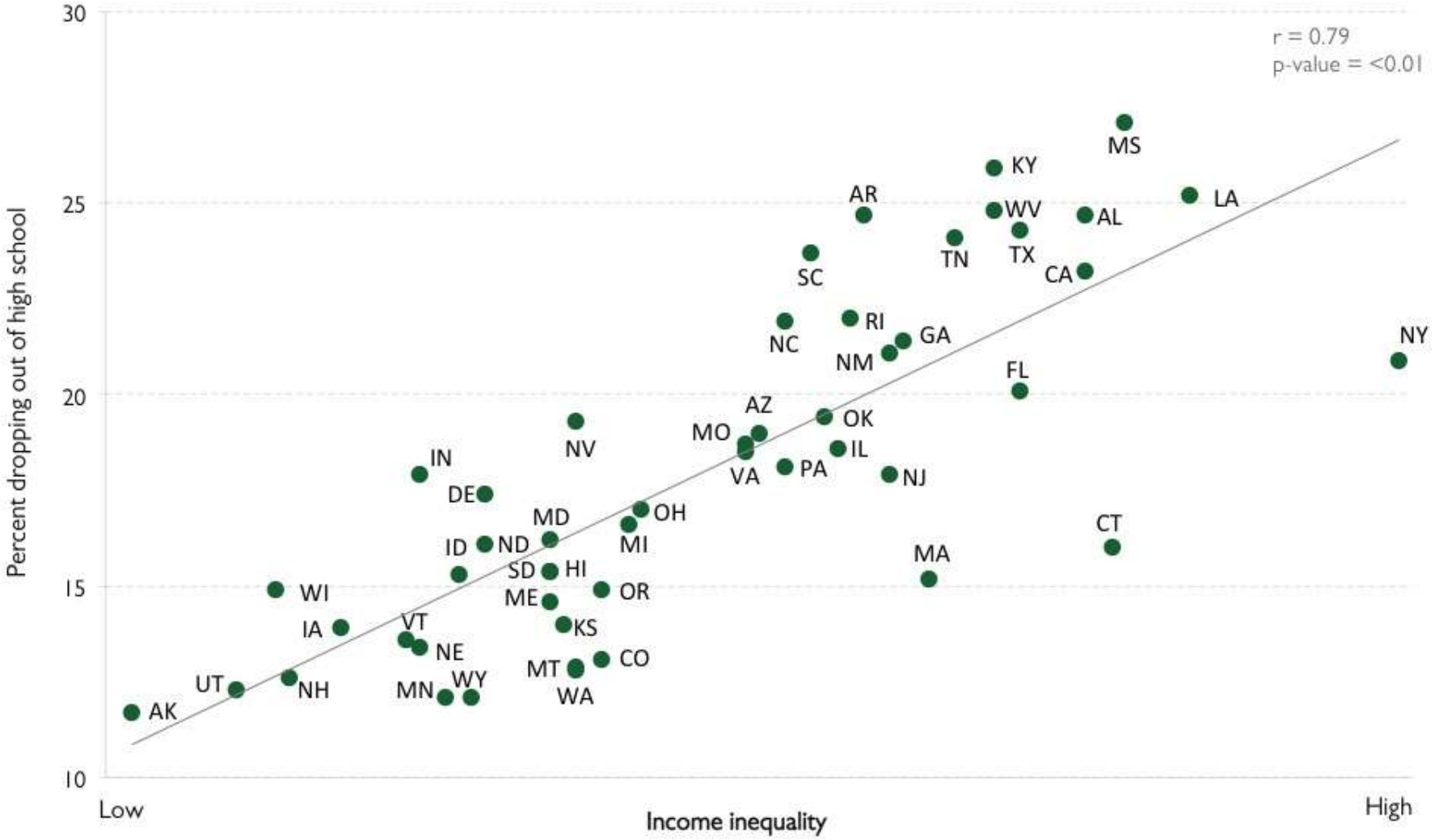
Source: Wilkinson & Pickett, The Spirit Level (2009)

Educational scores are higher in more equal rich countries



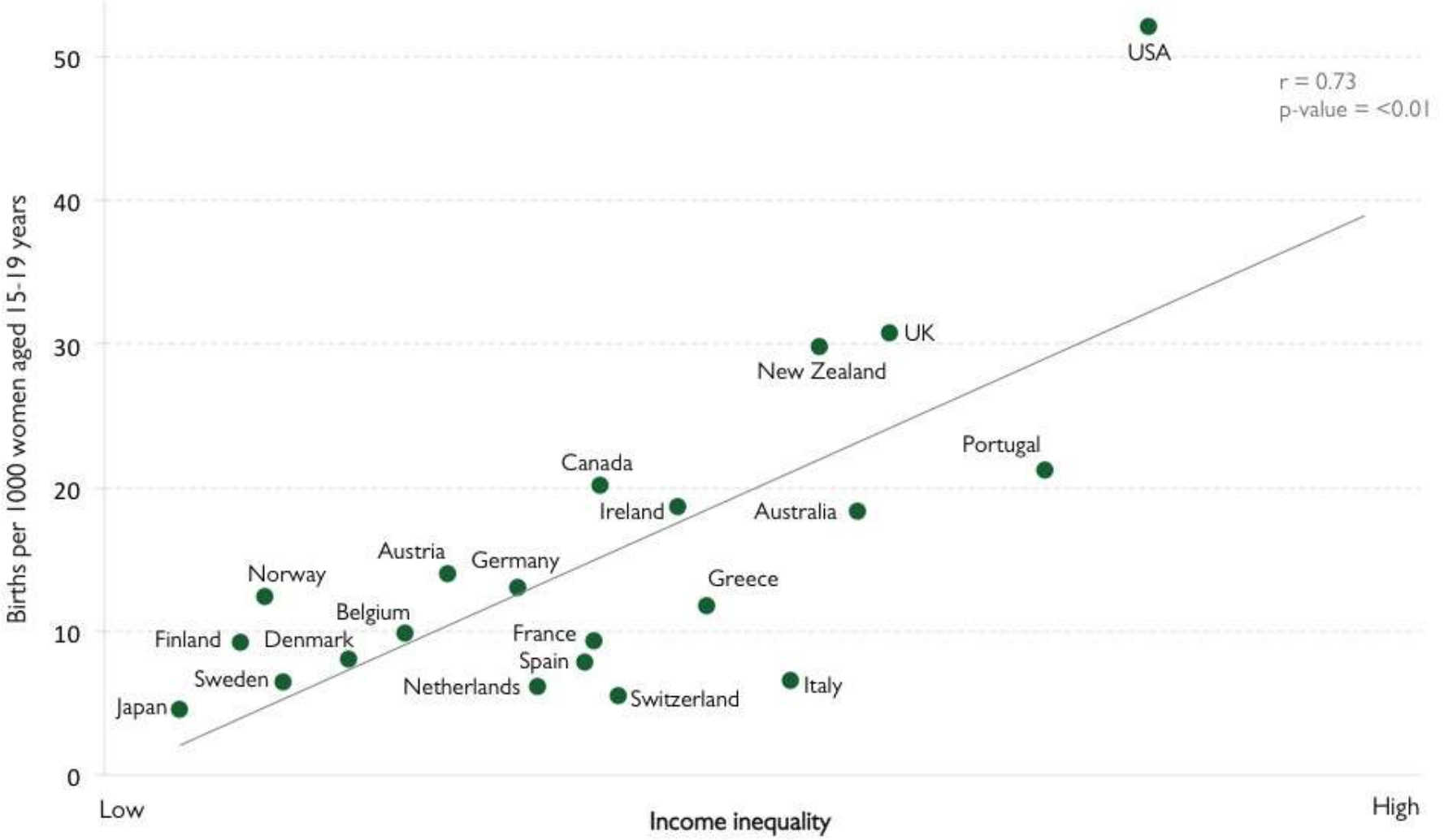
Source: Wilkinson & Pickett, The Spirit Level (2009)

More children drop out of high school in more unequal US states



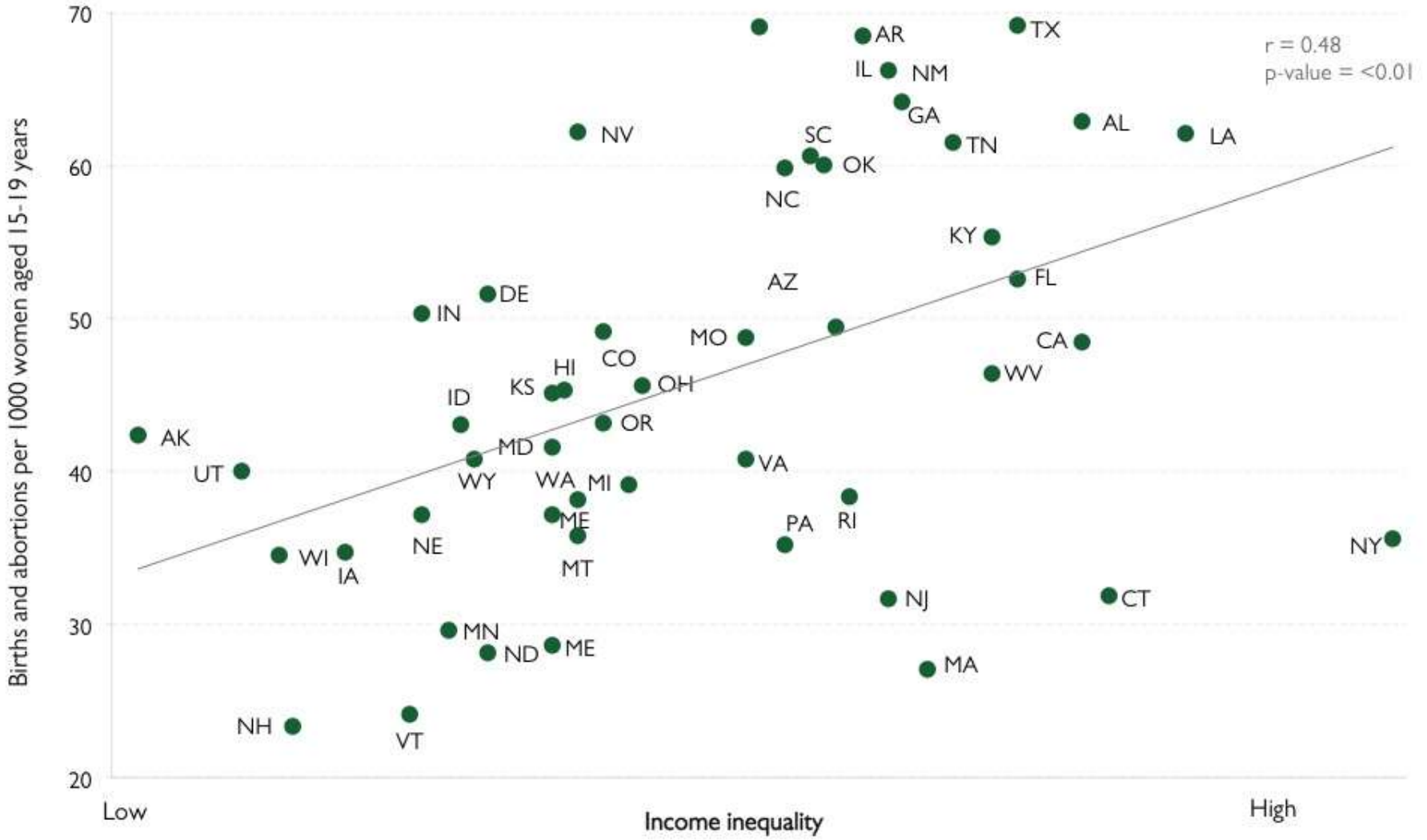
Source: Wilkinson & Pickett, The Spirit Level (2009)

Teenage birth rates are higher in more unequal rich countries



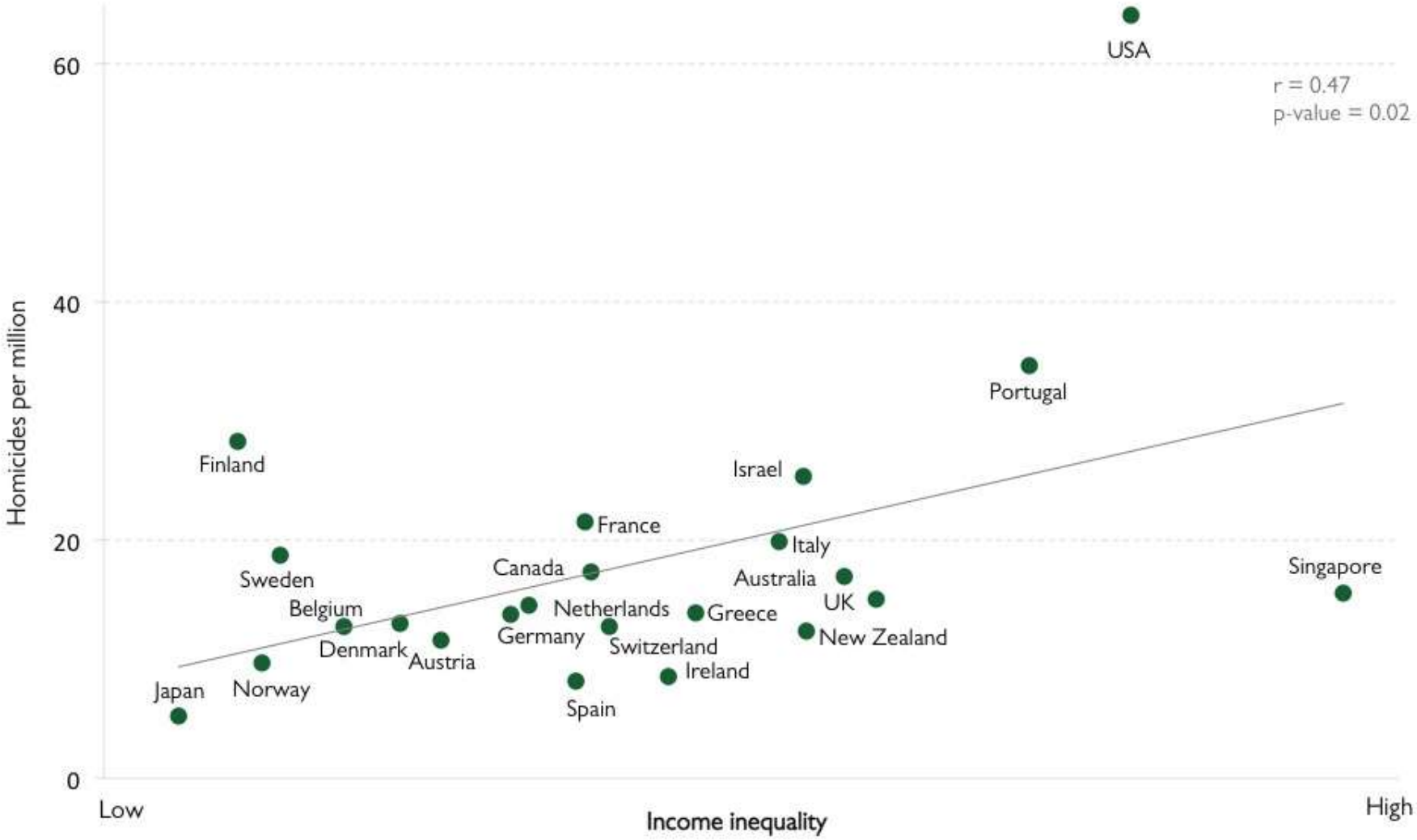
Source: Wilkinson & Pickett, The Spirit Level (2009)

Teen pregnancy rates are higher in more unequal US states



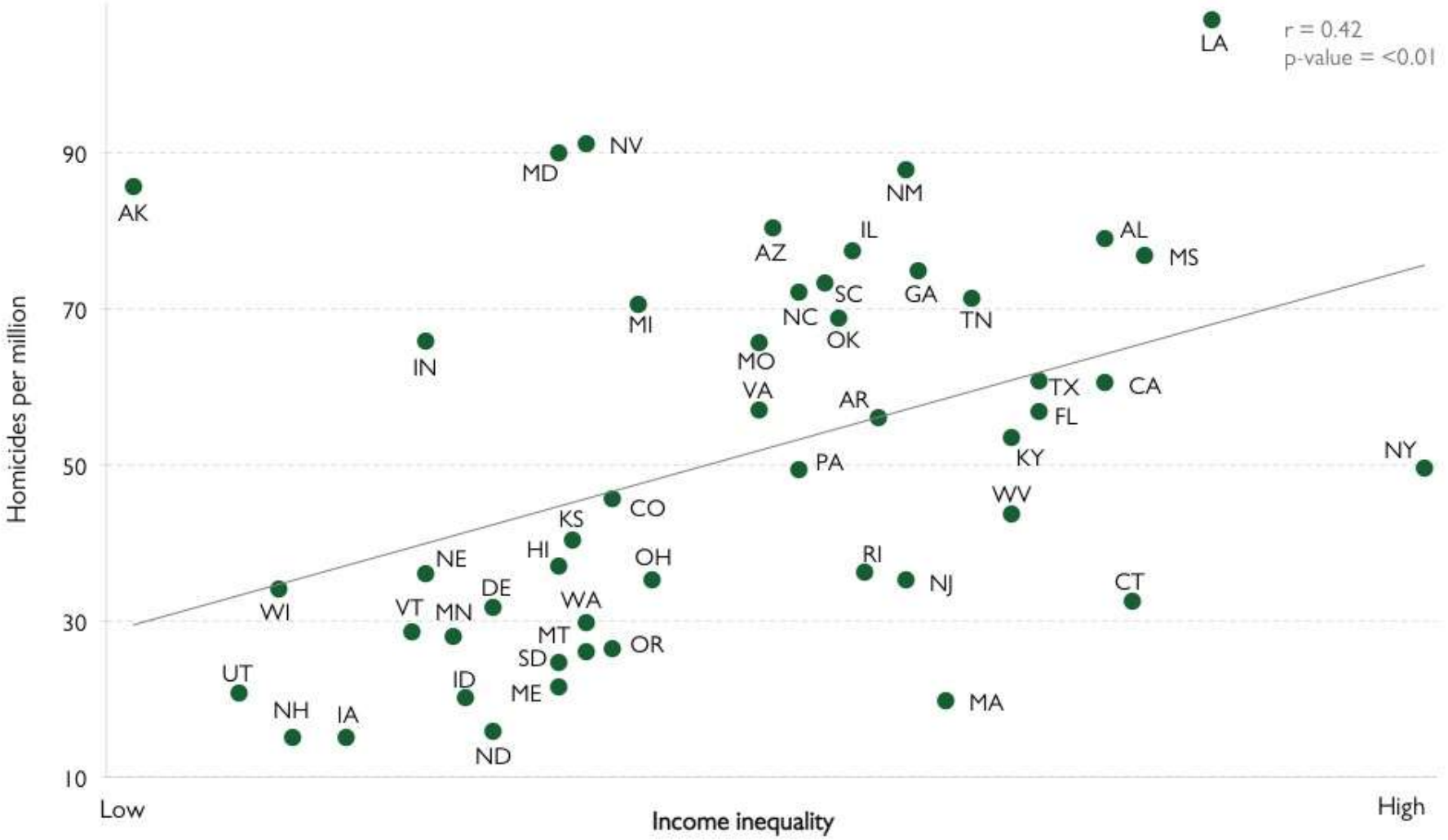
Source: Wilkinson & Pickett, The Spirit Level (2009)

Homicide rates are higher in more unequal rich countries



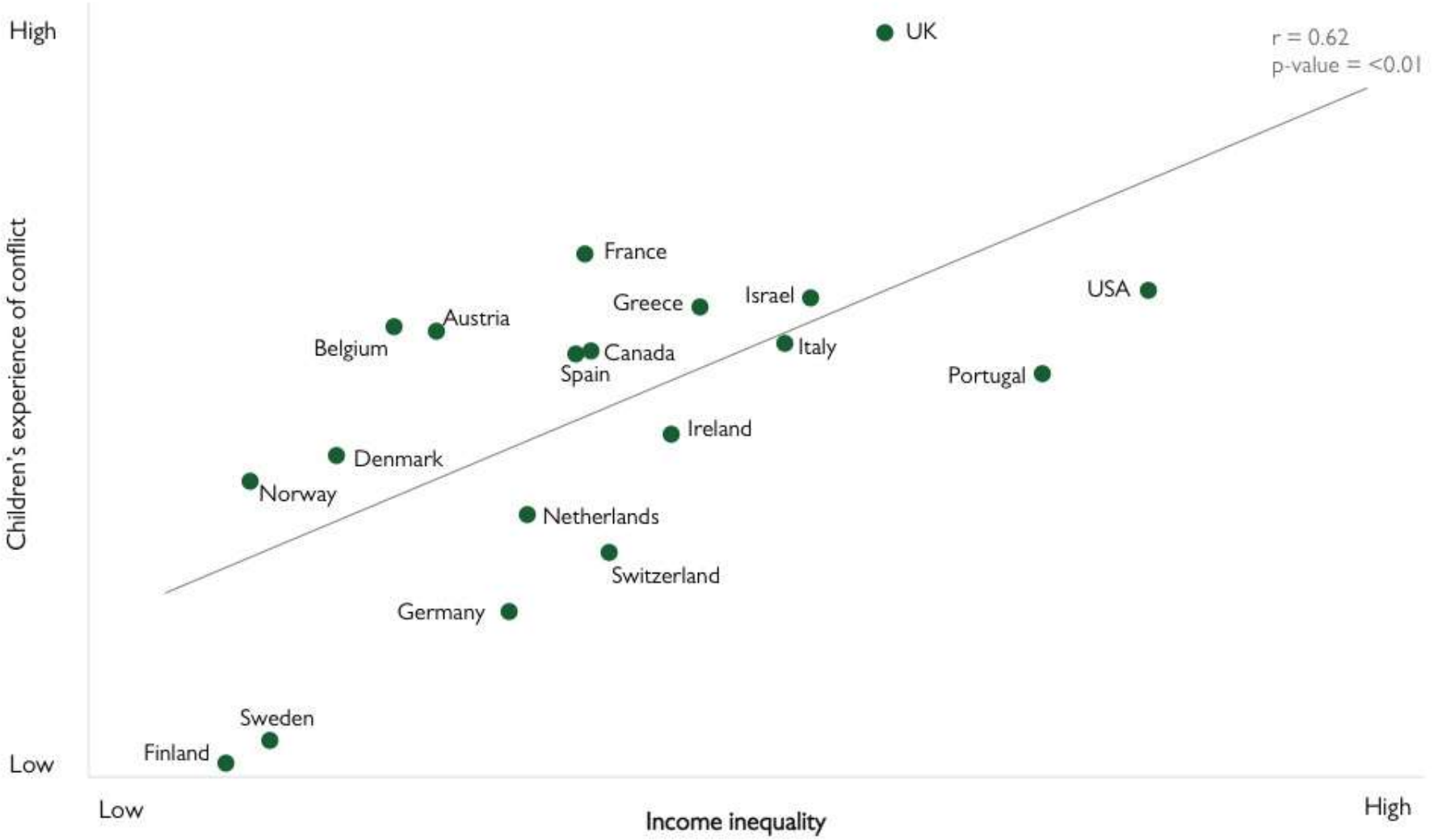
Source: Wilkinson & Pickett, The Spirit Level (2009)

Homicide rates are higher in more unequal US states



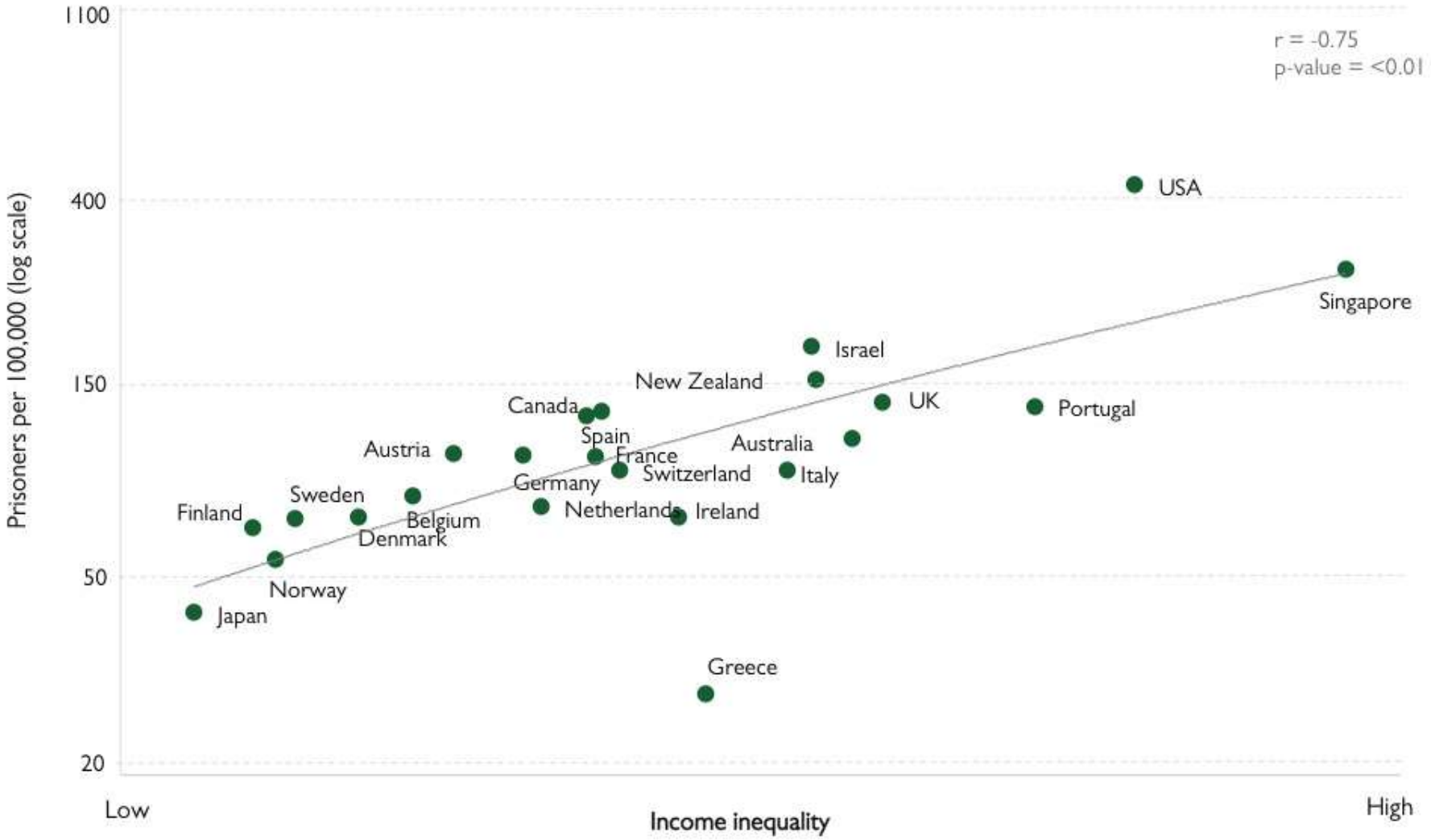
Source: Wilkinson & Pickett, The Spirit Level (2009)

Children experience more conflict in more unequal societies



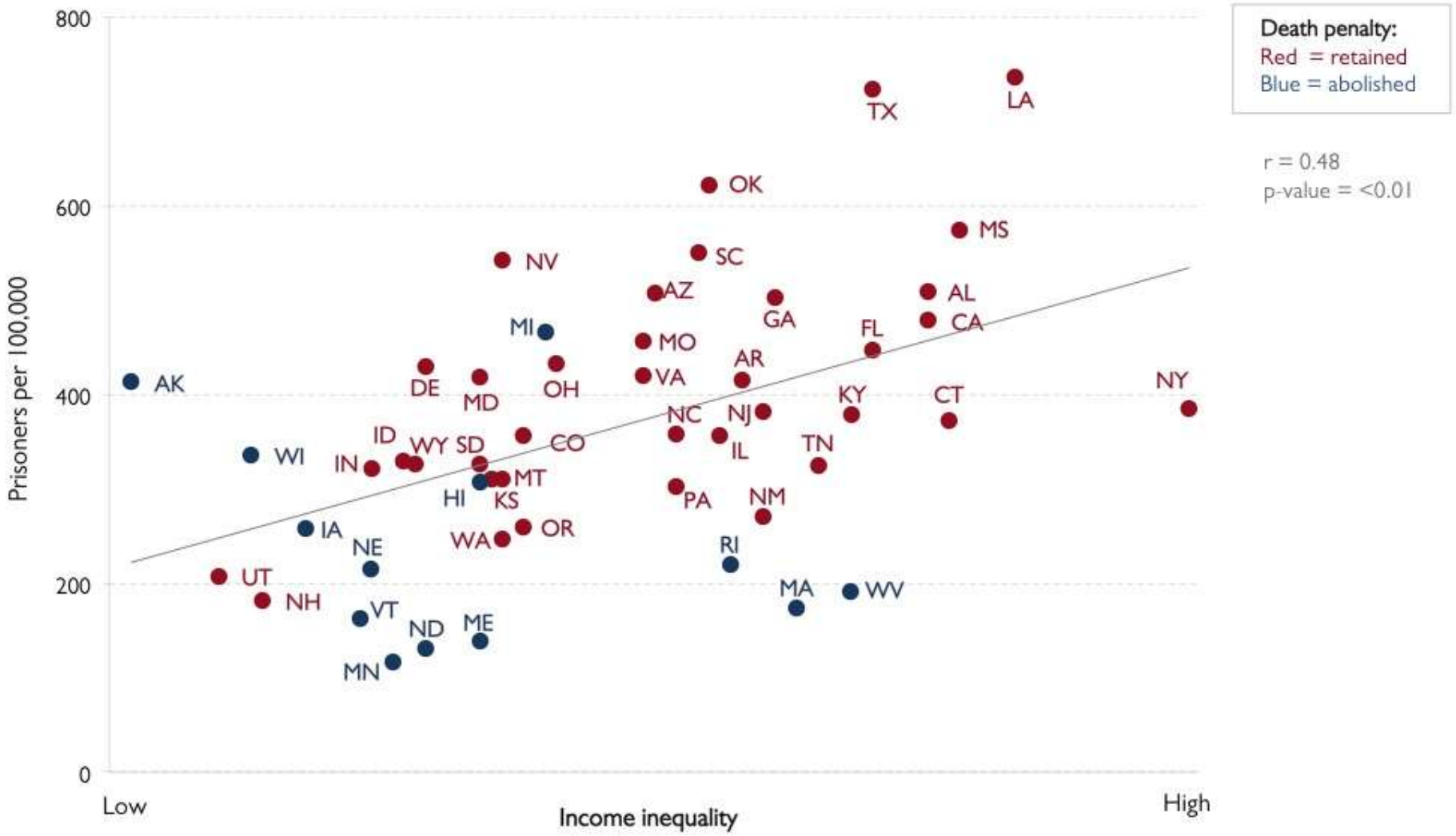
Source: Wilkinson & Pickett, The Spirit Level (2009)

Rates of imprisonment are higher in more unequal countries



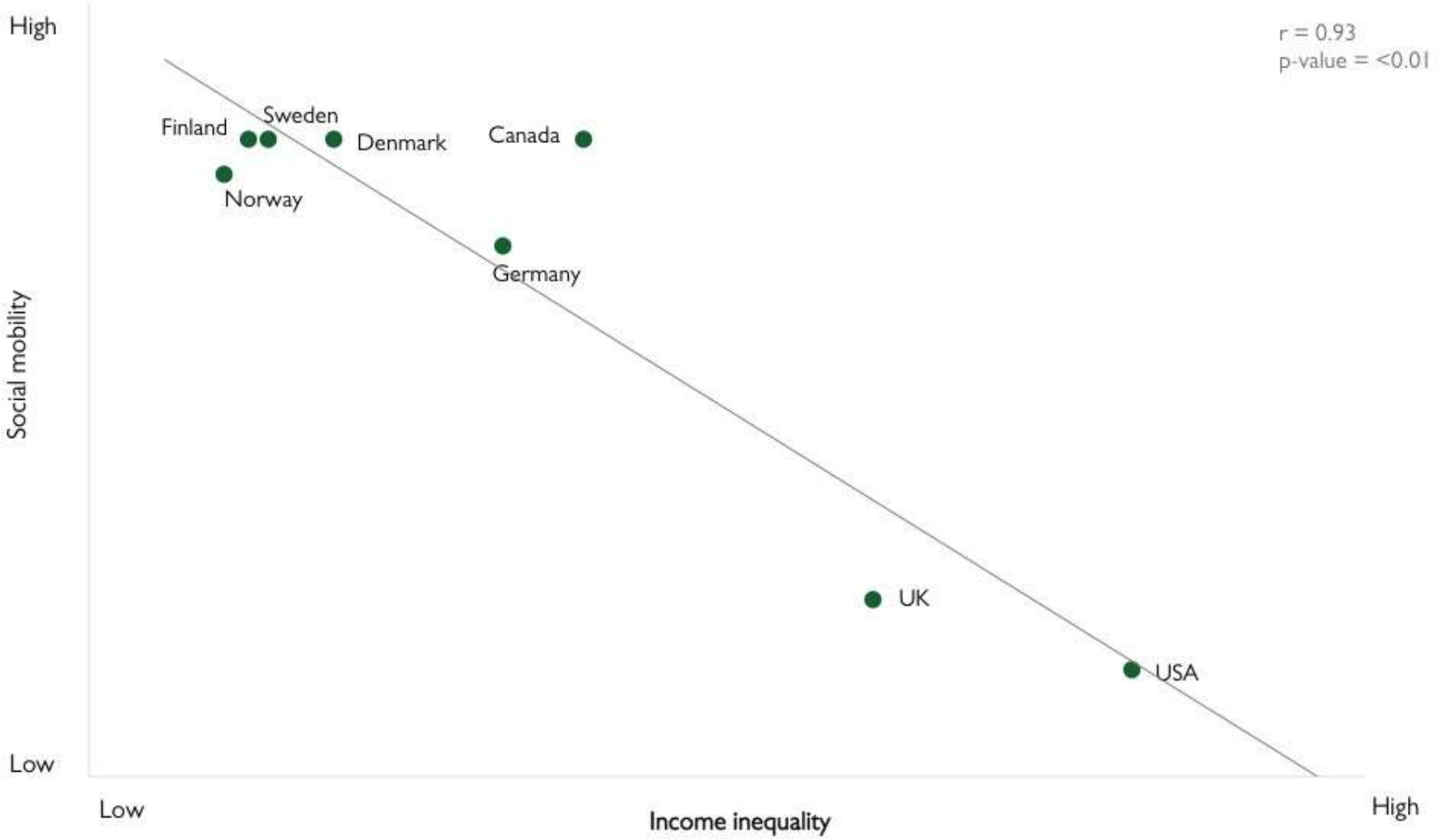
Source: Wilkinson & Pickett, The Spirit Level (2009)

Rates of imprisonment are higher in more unequal US states



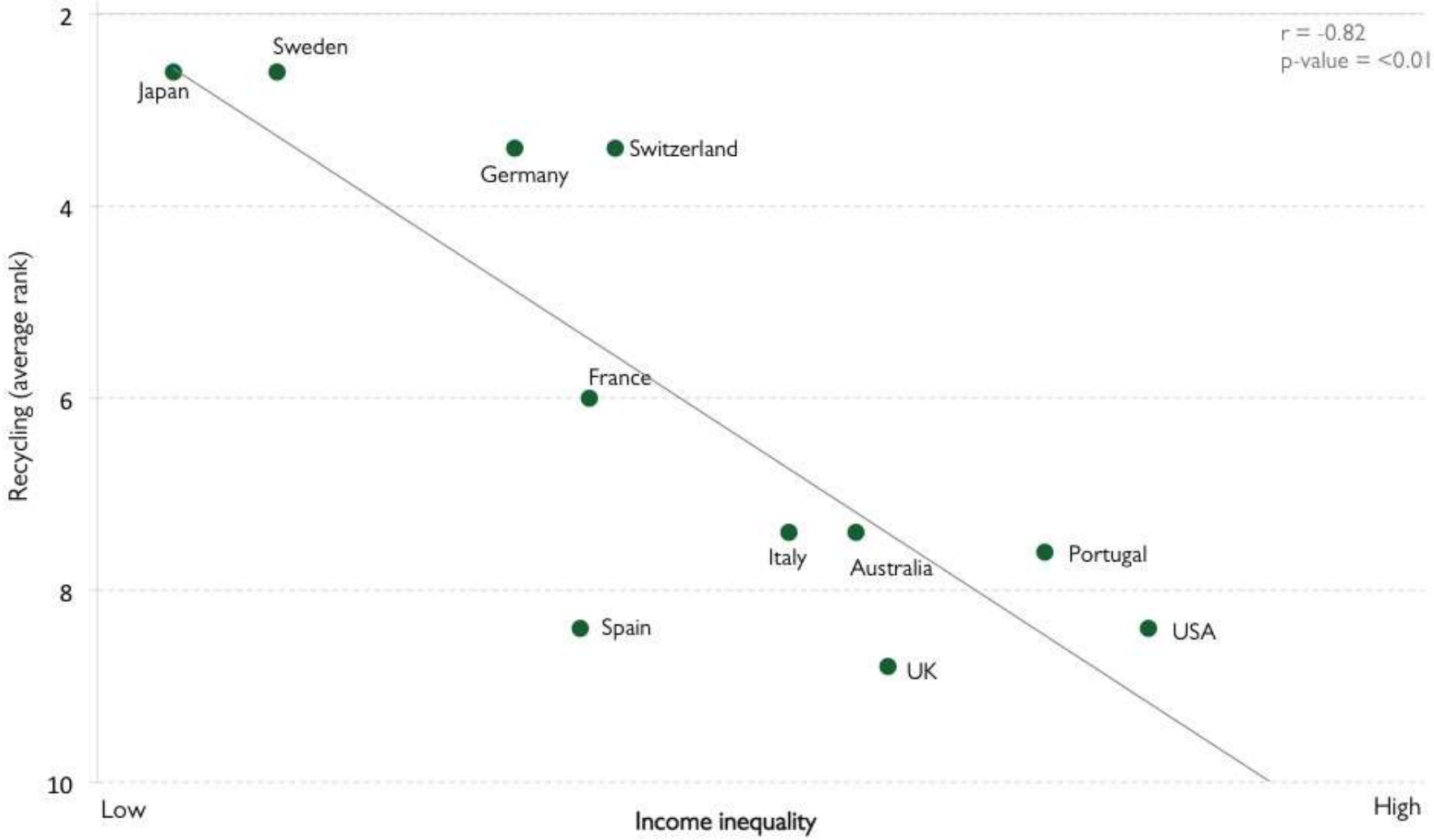
Source: Wilkinson & Pickett, The Spirit Level (2009)

Social mobility is lower in more unequal countries



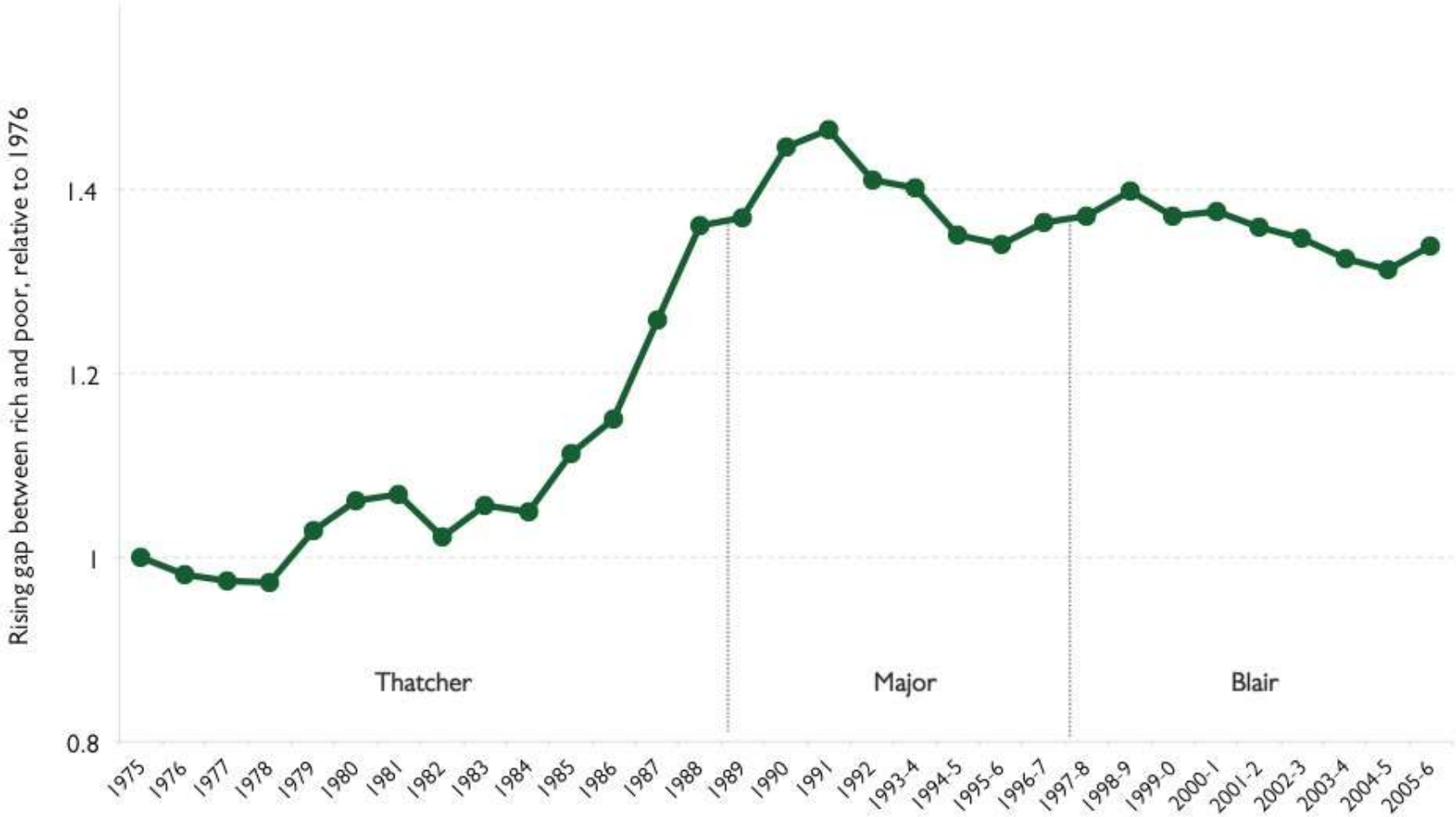
Source: Wilkinson & Pickett, The Spirit Level (2009)

More equal countries rank better (1 is best) on recycling



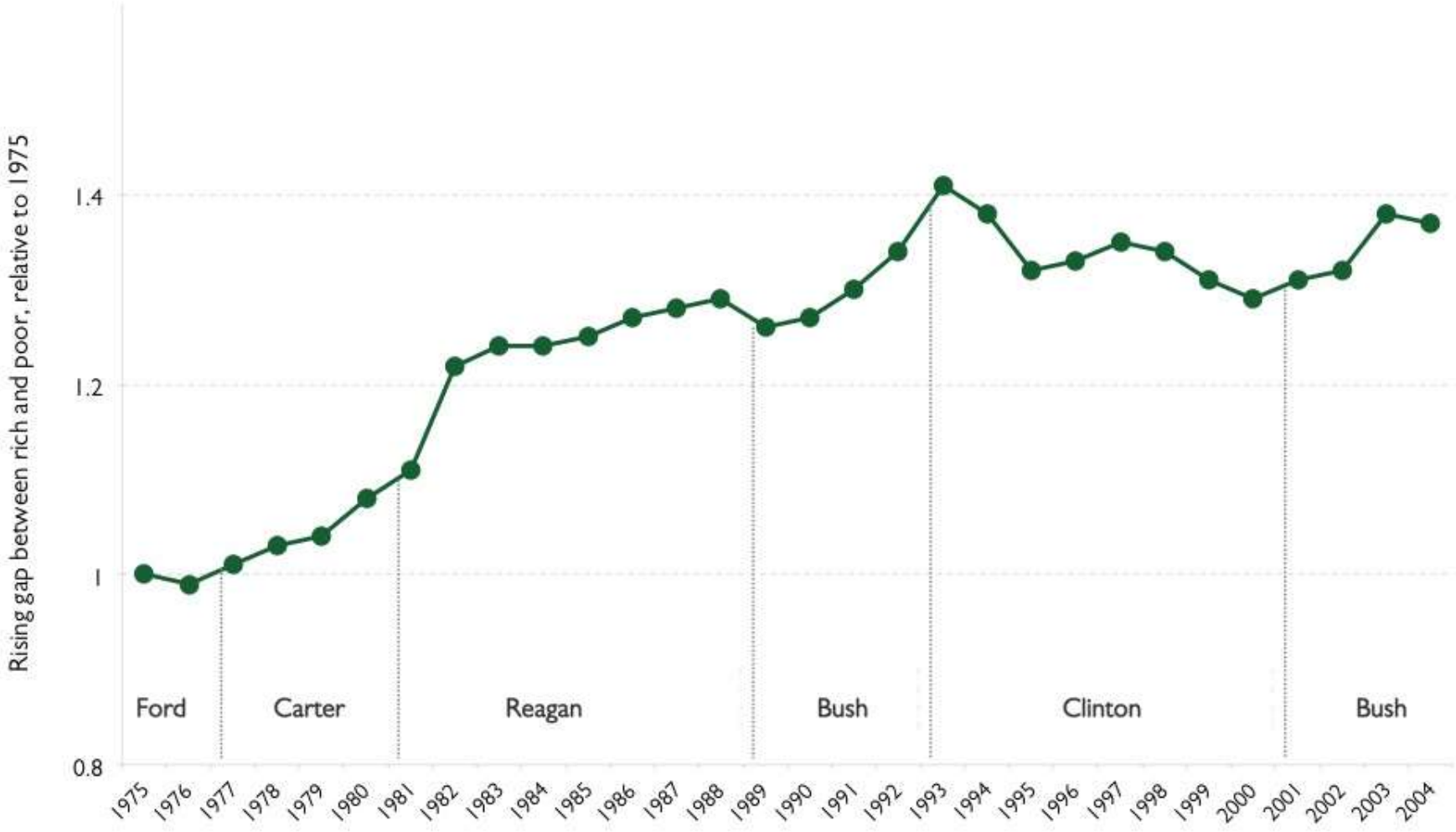
Source: Wilkinson & Pickett, The Spirit Level (2009)

Trends in UK income inequality 1979 – 2005/06



Source: Wilkinson & Pickett, The Spirit Level (2009)

Trends in US income inequality 1975 – 2005



Source: Wilkinson & Pickett, The Spirit Level (2009)

THE EQUALITY TRUST

www.equalitytrust.org.uk

GCSE and A level Geography 2016

Resources for telling stories with data

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- Data Skills in Geography
  - http://www.rgs.org/OurWork/Schools/Data+skills+in+geography/Data+skills+in+geography.htm

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Some additional resources

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- Geographers Count: A Report on Quantitative Methods in Geography, http://www.tandfonline.com/doi/full/10.11120/elss.2014.00035
- The Use and Abuse of Statistics (from Quantitative Geography: the basics), https://www.dropbox.com/s/tzc4b252pbtz2ck/chapter2-2.pdf?dl=0
- Videos and case studies of quantitative geography skills used in the workplace, https://quantile.info/careers/

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Session 2

Data, skills & progression

11:40 – 12:20pm

David Holmes

@dave905947

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Session outline

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1. This session will explore the value of quantification skills in school geography
2. We will think about how skills and data fit into the new GCSEs and AS/A level
3. There will also be an opportunity to consider the Pearson Progression Scale for Geography

Q. Why are data skills relevant?

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As Andreas Schleicher, OECD Deputy director for education, puts it:

"The world economy no longer pays for what people know but for what they can do with what they know."

Source:
TED Blog http://bit.ly/N1i4zC

Francis Maude, MP

"Data is the material of the new Industrial Revolution."

Source:
https://en.wikipedia.org/wiki/Francis_Maude#/media/File:Francis_Maude,_Minister_for_the_Cabinet_Office.jpg

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Take a moment...

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"Geographers require skills in the **presentation**, **interpretation**, **analysis** and **communication** of quantitative data. They are familiar with a range of statistical techniques including simple descriptive statistics, inferential tests and relational statistics such as correlation and regression; principles of research design and ways to collect data; the retrieval and manipulation of secondary datasets; and geospatial technologies such as digital cartography, Geographic Information Systems (GIS) and remote sensing. Attention is given to spatial statistics, to issues of spatial dependency, to spatial difference and to the effects of scale."

QAA University Subject Benchmark for Geography

A range of quantitative skills

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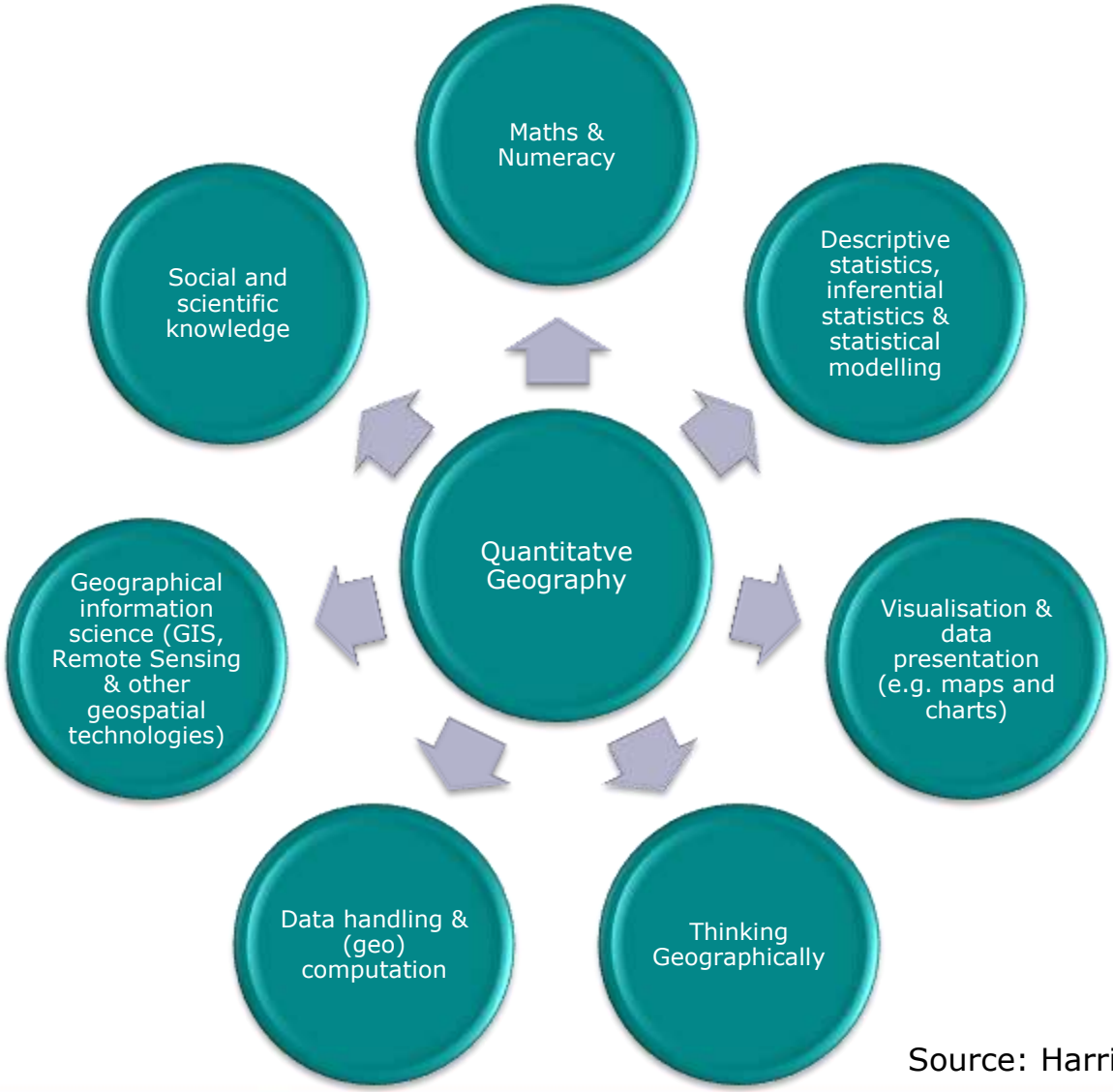
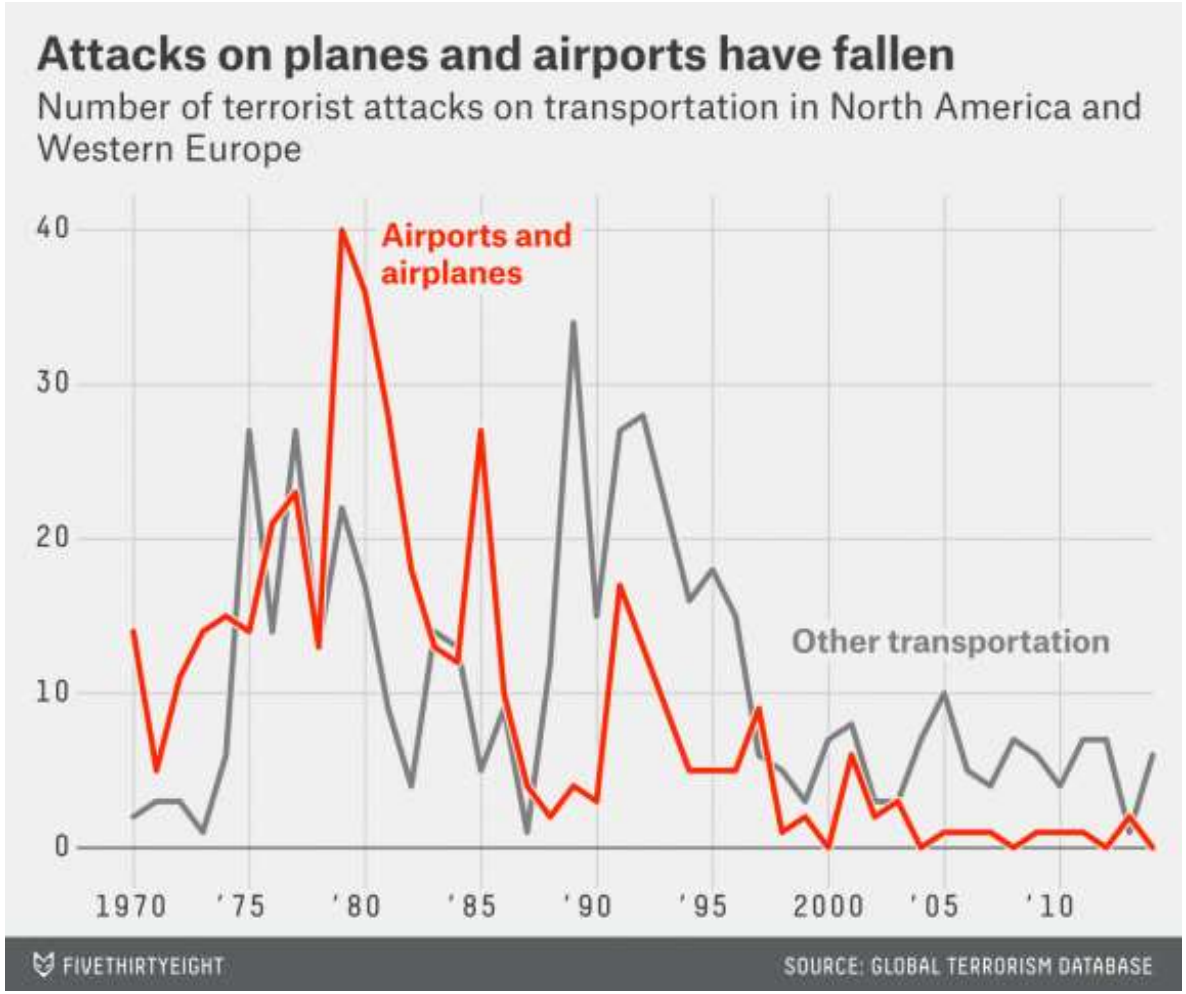


"Its more about the geography than the maths"

Source: Harris (2016): RGS

Q. What do you make of this?



Is it becoming more risky to travel in North America and Western Europe?

http://fivethirtyeight.com/features/attacks-on-transportation-targets-like-those-in-brussels-have-become-rarer/

A-level standards: change over time

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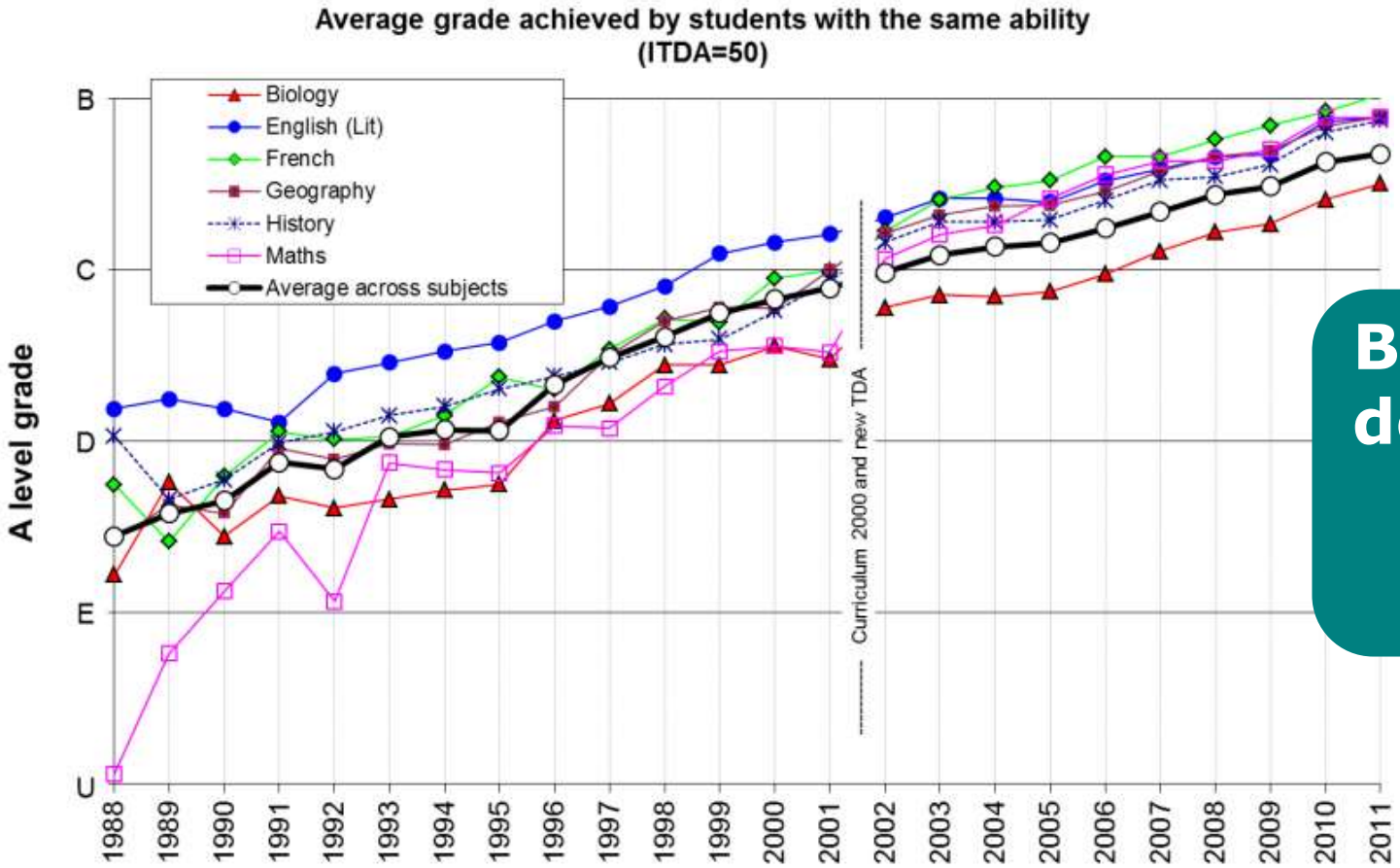

But what does this *really* mean?

Source: CEM, Durham University

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A similar story for GCSE

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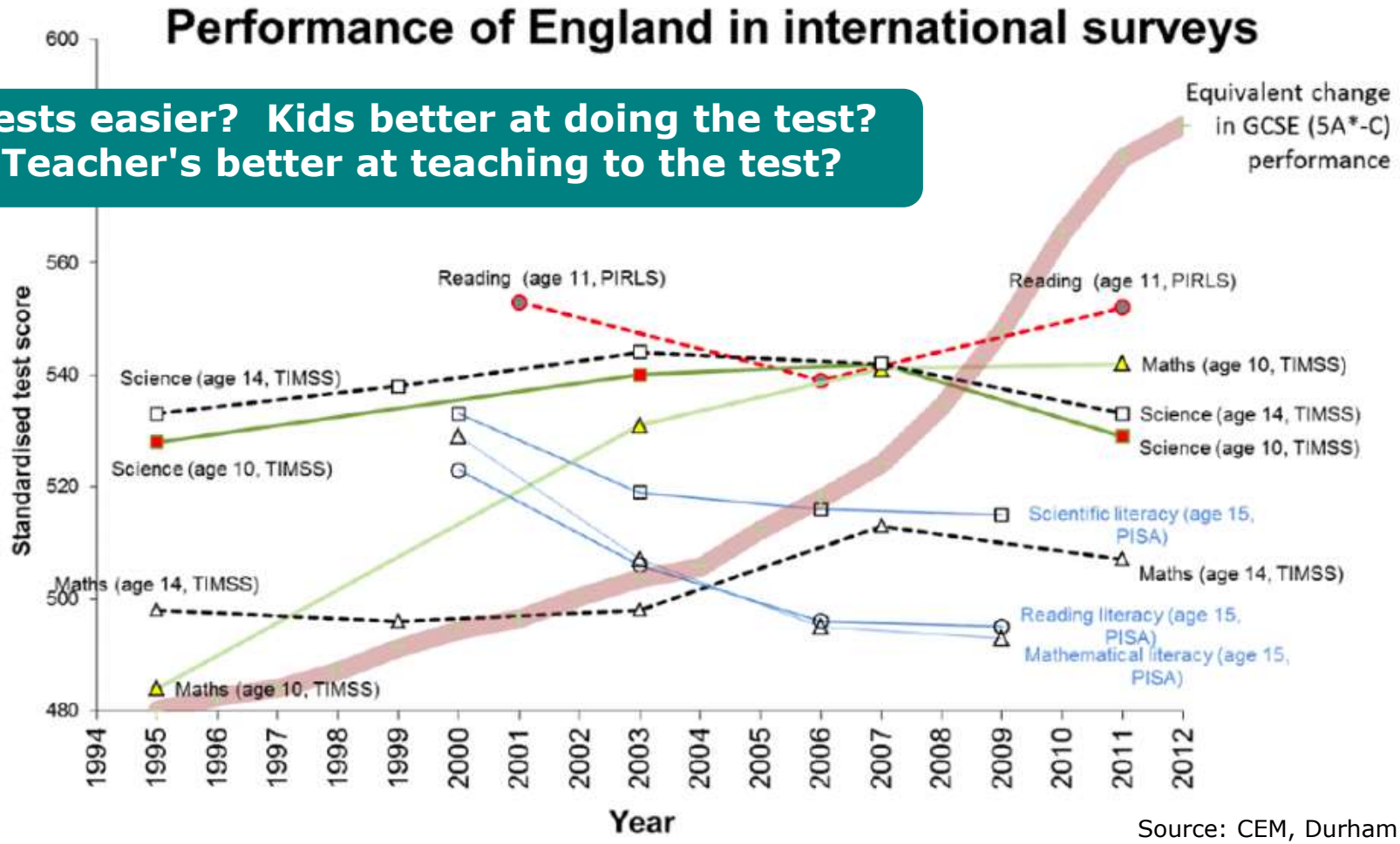
Tests easier? Kids better at doing the test? Teacher's better at teaching to the test?



Source: CEM, Durham University

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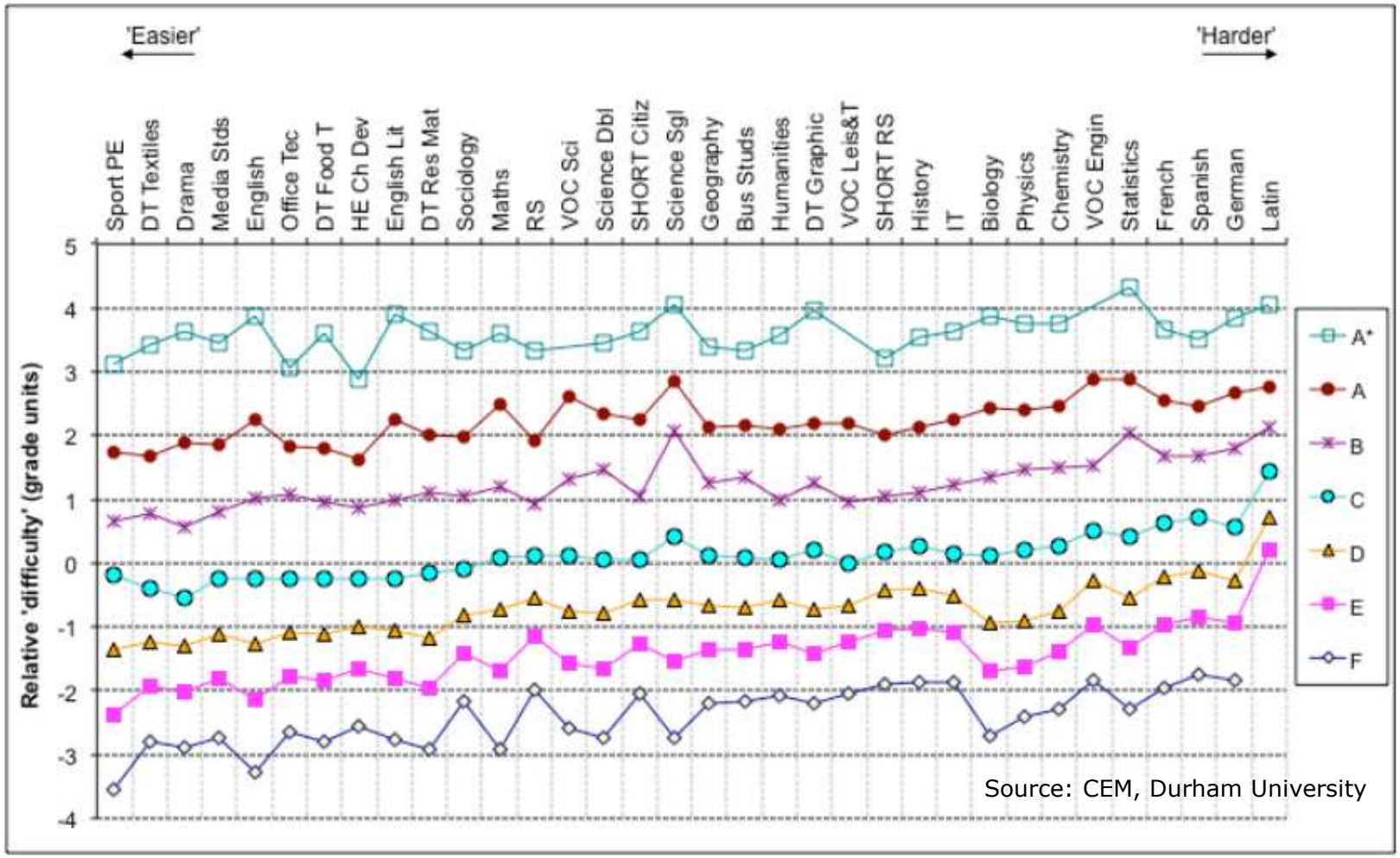
What about 'difficulty'?

This is a quantified analysis comparing 'difficulty' across subjects and then ranked...



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Why are we doing this….?

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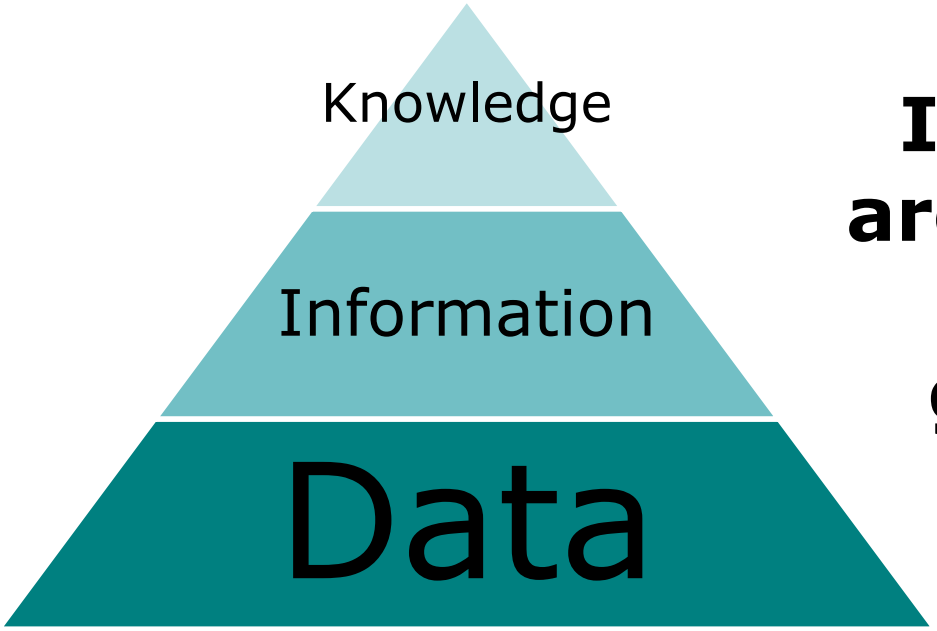
Manage → Visualise → Understand



Isn't this what we are trying to achieve when we "think geographically"?

Based on 'Open Data in a Day' by Dave Tarrant (Open Data Institute)

GCSE Geography A&B 2016

A quick reminder of the Assessment Objectives

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AO4: Select, adapt and use a variety of skills and techniques to investigate questions and issues and communicate findings.			*25% (5% used to respond to fieldwork data and context(s))*
Strands	**Elements**	**Coverage**	**Interpretations and definitions**
n/a	1a – Select a variety of skills and techniques to investigate questions and issues.	Full coverage in each set of assessments (but not every assessment).	▪ **Skills and techniques** are aspects of subject content. Awarding organisations should explain their approach to targeting them in their assessment strategy. ▪ **Questions** are geographical matters requiring resolution or discussion. ▪ **Issues** mean topics about which there can be debate or discussion. ▪ The emphasis in this assessment objective should be on the use of skills and techniques – and the weighting of element 1c should reflect this emphasis. ▪ Element 1d should be assessed in combination with one or more of the other elements. ▪ There are different ways in which findings can be communicated. This may include written responses or data responses. ▪ We do not expect individual tasks/questions to cover a variety of skills and techniques. ▪ We do not expect individual tasks/questions to cover both questions and issues.
	1b – Adapt a variety of skills and techniques to investigate questions and issues.		
	1c – Use a variety of skills and techniques to investigate questions and issues.		
	1d – Communicate findings.		

A level Geography 2016

A quick reminder of the Assessment Objectives

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	Students must:	AS Level	A-Level
AO1	Demonstrate knowledge and understanding of places, environments, concepts, processes, interactions and change, at a variety of scale	40%	34%
AO2	Apply knowledge and understanding in different contexts to interpret, analyse and evaluate geographical information and issues	35%	40%
AO3	Use a variety of relev… fieldwork skills to: • investigate geogr… • interpret, analyse… • construct argume…		

Mark tariff	1	2	3
Define	*		
Identify/State/Name	*	*	
Calculate	*	*	
Complete	*	*	
Draw/Plot		*	*

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Introducing the Pearson Progression Scale

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Note: steps 10 to 12 are still GCSE

Progression Scale and Map

Our Geography Progression Scale is a reliable, easy to use tool to track students' progress over Key Stage 3 and Key Stage 4. It comprises of 12 steps ranging from low (1) to high (12) challenge. We anticipate that the average student will enter year 7 working at the 3rd or 4th step. The expectation is that a student will make one Step of progress a year.

The Progression Map builds on the Scale, breaking down the curriculum with clear process descriptors, any prior knowledge required and boosters for additional challenge. This provides you with a more detailed view of how learning progresses across each of the 12 steps.

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Pearson Progression Scale: Starting out...

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Strand	Assessment Objective	Progress descriptor	Step
Application of Geographical Skills	AO4	Pupils can recognise patterns of both human and physical features on a limited range of scales. They can draw and label simplistic sketches and recognise basic map symbols. They can construct basic graphs such as bar graphs which will be accurately completed. They can recognise the highest and lowest values in a data set as well as complete basic calculations such as the range of the data.	1st
Application of Geographical Skills	AO4	Pupils can describe the patterns of human and physical features as well as draw and label a sketch map. Simplistic observations of photographs and sketches will be made. They will recognise and use map symbols and begin to have a working understanding of 4 figure grid references and straight line distances. Pupils can construct a range of graphs such as a bar and line graph and use increasing statistical skills such as working out the mean and median values.	2nd
Application of Geographical Skills	AO4	Pupils can describe distributions of physical and human features and be able to sketch, label and start to annotate sketch maps and photographs in greater depth. Pupils have an increasing working knowledge of OS map skills and can use 4 figure referencing with increasing confidence. Pupils will start to use GIS and interpret data presented in this format. Graphical skills will become more sophisticated and pupils will demonstrate an understanding of the data through statistical skills such as mode and modal class.	3rd

GCSE and A level Geography 2016

Pearson Progression Scale: At the top...

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Strand	Assessment Objective	Progress descriptor	Step
Application of Geographical Skills	AO4	Pupils can demonstrate a wide range of geographical skills. Pupils will be able to clearly recognise patterns of human and physical features and be able to interpret these on a range of scales. Pupils can draw and annotate cross sectional diagrams using OS maps, and annotate these with the specific physical and human features relevant to the area under study. Pupils can draw and interpret a variety of graphs and mapping techniques such as choropleth, and analyse the patterns using a range of statistical (e.g. cumulative frequency) and numerical (e.g. magnitude and frequency) skills.	10th
Application of Geographical Skills	AO4	Pupils can demonstrate an extensive range of geographical skills to describe, interpret and analyse geographical patterns and trends. Pupils can recognise geographical patterns and interpret the trends using a range of statistical skills to help such as mean, mode and median. Pupils can describe the data using measures of central tendency and clearly identify anomalous values within the data set. From this pupils are beginning to suggest reasons why these anomalies exist. The use and understanding of the role of GIS in geography will be demonstrated with growing confidence.	11th
Application of Geographical Skills	AO4	Pupils can demonstrate exceptional use of geographical skills to describe, interpret, analyse and evaluate geographical patterns and trends. Pupils can use a range of maps and atlases at various scales with confidence. Pupils can draw more sophisticated cartographical maps and graphs and use sophisticated statistical calculations to analyse the data displayed. Pupils can describe relationships within data sets using sophisticated numerical skills such as measures of central tendency and quartile and inter-quartile range. From this pupils can clearly recognise anomalies within the data set, offering comprehensive suggestions for why these exist. The use and understanding of the role of GIS in geography will be demonstrated with confidence.	12th

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All 4 Strands Mapped together

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Step 7	Pupils recall basic information about physical and human environments, with a growing appreciation of different scales. They demonstrate simplistic knowledge of location through specific case studies with geographical ideas referred to in a simple manner. Pupils understand simple physical and human processes. Pupils begin to understand how the different views of people have different effects on how environments are used and managed. Pupils conduct a geographical enquiry, collecting appropriate data (primary and secondary). Pupils attempt to make brief comments about the data, with limited conclusions attempted and offer an evaluation often focused on one aspect of the enquiry. Pupils have a good understanding of how cartographical and OS skills can be used to describe and interpret geographical patterns. Pupils understand a range of graphical techniques and how to interpret the data presented. Pupils demonstrate a range of graphical skills and interpret different types of photographs from a range of different landscapes. Pupils clearly link photographic evidence to OS maps. Pupils use more sophisticated statistical skills e.g. percentage change or cumulative frequency as a means of analysing data.
Step 8	Pupils recall a wider variety of information about physical and human environments. They show some understanding of the location of these environments through case study detail with appropriate key terminology used. Pupils recognise the inter-relationships between proocesses at different scales. Pupils understand that these processes help develop geographical patterns and that these areas have specific characteristics. Pupils understand how the relationship between people and environments inter-link, and trying to achieve sustainable development will affect planning and management of these areas. Pupils conduct a geographical enquiry, identify key questions or hypotheses to support, suggest an appropriate sequence of investigation, and collect appropriate data (primary and secondary) to help support the enquiry. This is collated and presented using simplistic techniques but they begin to produce more sophisticated techniques. Pupils communicate their findings in more detail with plausible conclusions offered, as well as evaluation offered for several aspects of the enquiry. Pupils clearly understand cartographic and OS map skills and use these to interpret patterns of human and physical features at a local, national and worldwide scale. Pupils have good graphical skills and can draw and interpret data on sophisticated graphs e.g. choropleth and flow line maps. Pupils use numerical and statistical skills to interpret data sets, highlighting trends and anomalous values.
Step 9	Pupils recall some accurate detail about physical and human environments studied with an appreciation of a wider scale. They demonstrate increasing use of case study specific knowledge and use appropriate key terminology with some accuracy. Pupils begin to describe the factors (physical, historical and economic) that affect the characteristics of places. Pupils discuss a range of processes relating to both physical and human environments, appreciating how they contribute to geographical patterns. Pupils begin to show understanding of how these processes interact causing diversity and independence. Pupils understand how links are made between people and the environment, appreciating that sustainable development will affect planning and management of environments. Pupils conduct a geographical enquiry, and identify key questions or hypotheses to support. Pupils begin to offer some contextualisation of their enquiry. They suggest an appropriate sequence of investigation and discuss the reasons for using particular data collection techniques. Pupils communicate their findings in greater depth, offering links to appropriate geographical theories, with plausible conclusions offered, as well as evaluation of several aspects of the enquiry. Pupils demonstrate excellent use of geographical skills and use these to describe the distribution and patterns at a range of scales using a variety of different maps. Pupils draw and interpret a variety of different cartographical skills and interpret the data presented using a wide range of numerical and statistical skills.
Step 10	Pupils recall detailed information about physical and human environments studied, across all scales and include appropriate case study detail and location. Pupils demonstrate their understanding of a range of geographical processes, beginning to apply their understanding to unfamiliar contexts. Pupils interpret the characteristics of their chosen case study or example, and link them to both physical and human geography. Pupils recognise that sustainable development in these areas is important, and that opinions, including their own, will vary depending on the stakeholders involved. Pupils appreciate the need for a more sustainable approach to the planning and management of physical and human environments, using some supporting examples. Pupils conduct a geographical enquiry, and identify appropriate key questions or hypotheses to support, offering greater contextualisation for their enquiry. Pupils collect primary and secondary data, and collate and present their findings using more sophisticated techniques e.g. located graphs (bar graphs and pie charts). From this, pupils analyse their data, offer an interpretation of the results and use their geographical understanding to link the evidence to relevant theory with more confidence. Pupils evaluate the process of enquiry and make suggestions for improving the limitations, reliability and validity of the conclusions. Pupils clearly recognise patterns of human and physical features and interpret these on a range of scales. Pupils draw and interpret a variety of graphs and mapping techniques e.g. choropleth and analyse the patterns using a range of statistical skills.
Step 11	Pupils accurately recall the characteristics of physical and human environments across all scales, using the location of specific case studies and complex key terminology. Pupils demonstrate understanding of geographical processes, applying these with greater accuracy to unfamiliar contexts. Pupils understand how human processes interact with physical processes to help develop geographical patterns and consider the interdependence between human and physical geography. Pupils demonstrate how this impacts on management of environments by evaluating the values and attitudes involved in managing and making decisions, appreciating that opinions of stakeholders vary. Pupils appreciate the need for a more sustainable approach to the planning and management of these environments. Pupils conduct a geographical enquiry, and identify appropriate key questions or hypotheses, offering some supported predictions. Pupils accurately collect primary and secondary data, collate and present their findings using a range of skills. From this, pupils analyse their data, interpret the results and begin to substantiate their conclusions with some linkage to the underpinning geographical theory. Pupils evaluate the process of enquiry and make suggestions for improving the limitations, reliability and validity of the conclusions. Pupils demonstrate an extensive range of geographical skills to describe, interpret and analyse geographical patterns and trends. From this, pupils begin to suggest reasons why these anomalies exist.
Step 12	Pupils accurately recall the precise characteristics of physical and human environments across a variety of spatial settings, using detailed knowledge of case studies supported by comprehensive terminology. Pupils demonstrate an understanding of complex geographical processes, applying these with precise accuracy to unfamiliar contexts. Pupils thoroughly understand how human processes interact with physical processes to develop more complex geographical patterns. Pupils demonstrate how this impacts on management of physical and human environments by assessing the values and attitudes involved in managing and making decisions, appreciating that the opinions of stakeholders will vary considerably. Pupils appreciate the need for a more sustainable approach to the planning and management of environments, and evaluate the costs and benefits. Pupils conduct a geographical enquiry, identify appropriate hypotheses or key questions, and provide detailed supporting predictions. Pupils accurately collect primary and secondary data, collate and present their findings, analyse their data, interpret the results and substantiate their conclusions with linkage to underpinning geographical theory. Pupils understand how to critically evaluate their enquiry and make suggestions for improving the limitations, reliability and validity of the conclusions. Pupils draw more sophisticated cartographical maps and graphs and use sophisticated statistical calculations to analyse the data displayed, recognising why anomalies might exist.

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An early quantitative skills progression map

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A possible quantitative, mathematical and geographical skills progression map: KS3 - GCE

General data and information skills, spatial and geospatial, data analysis and specific skills

	KS3	+ KS4 Context and detail	+ GCE
Seeing significance in data	**Recognising that facts information and statistics can be analysed in order to develop new knowledge. Know how to access open data. Understating different types of numerical data: pdf, .xls, .csv, http/…. Etc.**		**Being able to critically reflect on the provenance of open and other source data sets. Recognising the need for ethical treatment of data, information the owners of such information.**
Basic data manipulation and management	Handing small data sets (1-20 items). Sorting and ordering, manually and using a spreadsheet. Begin to ask geographical questions linked to meaning in the data	Large data set management (>100 rows downloaded) and use of spreadsheet tools to manage, filter, sort and identify anomalies. Being able to contextualise "big numbers" relevant to geography, include concepts around magnitude	Manage large complex data sets. Estimations and predictions; using knowledge to explore and understand data and information in unfamiliar circumstances.
Data visualisation	Collaborative searching and understanding of different types of visualisation	Individual searching and understanding through creative exploration. Recognising limitations of visualisation	Individual searching, referencing, understanding and critical reflection of published information.
Graphical skills	Present data and information using different techniques. The importance of scales and to be able to summarise meaning from data presented	Recognising limitations of different graphical techniques, and the ability to introduce bias (deliberately or not). Analyse graphical information to explore rates of change, including linear vs log scales.	Explore data "correctness" as an idea, evaluate different presentation techniques using technical language.
GIS mapping	Measure distances, scales, areas, routes. Create own simple content and links to other resources, e.g. images	Import data from other sources, make layers and use mapping tools to present complex data in a meaningful way	Understand different types of map, e.g. vector vs raster, import big data, carry out basic analysis, filter, experiment with different types of map.
Cartographical skills (including digital visions)	General map and atlas skills, distances, area, scale, gradient etc. Different types of key maps understood. Be able to describe information from the map using appropriate geographical language and terminology.	Moving between different scales, areas and different map projections. Make reasonable estimations in different units.	Critical reflection on map presentation, representation, identity. Develop own criteria and scale for judging reliability of data and information. Recognising limitations and bias in infographics
General Data analysis	The language and basic tools of data analysis, e.g. indexes and indices, frequencies, percentages, ratios, fractions, proportions etc. Use of specific plots to represent data, e.g. scatter as precursor to other understanding.	Calculate measures of central tendency: standard deviation, interquartile, and critical reflection on approach. Precision and accuracy in data. Categorical, ordinal, interval data. Limitations of models in respect of geographical understanding and data analysis	Data uncertainty, problems of data sampling (representativeness, population context). Critique of the scientific route to enquiry ("data cycle") as a process to generate geographical answers.
Specific qualitative and quantitative skills (including fieldwork)		Understand the need for some statistical tools to extract meaning from data and information, but recognise limitations. Explaining common landscapes, mental maps, participant observation, high quality photography (including self-directed) and analysis, e.g. coding	Undertake inferential statistics, evaluating different approaches to hypothesis testing, Chi, Lorenz curves, Gini, Nearest Neighbour, Mann Whitney* "Reading landscapes" in novel contexts and situations. Being cautious and sceptical of outcomes from different people and organisations

*will be different demands according to different specifications.

GCSE and A level Geography 2016

Where do quantitative skills fit into this?

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Metacognition, T&L expertise, meta-analysis

Keeping up to date + research

Specification & test

Pedagogy

Mastery

Assessment

Therefore supporting good academic results in the future!

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AS and A level 2016 Geography

Session 3

Visualising Data & the NEA

1:10 – 1:55pm

David Holmes

@dave905947

david@david-holmes-geography.co.uk

Session Outline

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- This session will be a participatory workshop exploring a variety of methods used to present data

- We will also look at how students might use these sources of data to develop contexts and methodologies for the A level Independent Investigation

A level Geography 2016

Task & context

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- Your task is to consider the available contexts for an investigation on the Regenerating or Diverse Places topics… and then design a research question/hypothesis as well as establish field methodologies and data collection procedures.
- Feel free to collaborate with other delegates.
- You have about 15 minutes and then we will feed back at the end.

The remaining slides in this presentation provide a 'smorgasbord' of resources.

Miss Maud Smorgasbord Restaurant, Australia

A level Geography 2016

Specification detail – Topic 4A

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Topic 4: Shaping Places

Option 4A: Regenerating Places

Overview

Local places vary economically and socially with change driven by local, national and global processes. These processes include movements of people, capital, information and resources, making some places economically dynamic while other places appear to be marginalised. This creates and exacerbates considerable economic and social inequalities both between and within local areas. Urban and rural regeneration programmes involving a range of players involve both place making (regeneration) and place marketing (rebranding). Regeneration programmes impact variably on people both in terms of their lived experience of change and their perception and attachment to places. The relative success of regeneration and rebranding for individuals and groups depends on the extent to which lived experience, perceptions, and attachments to places are changed.

Students should begin by studying the place in which they live or study in order to look at economic change and social inequalities. They will then put this local place in context in order to understand how regional, national, international and global influences have led to changes there. They should then study one further contrasting place through which they will develop their wider knowledge and understanding about how places change and are shaped.

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Specification detail – Topic 4B

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Topic 4: Shaping Places

Option 4B: Diverse Places

Overview

Local places vary both demographically and culturally with change driven by local, national and global processes. These processes include movements of people, capital, information and resources, making some places more demographically and culturally heterogeneous while other places appear to be less dynamic. This creates and exacerbates considerable social inequalities both between and within local areas.

Variations in past and present connections with places lead to very different lived experiences of places at a local level. This is because demographic and cultural changes impact variably on people in terms of the lived experience of change and their perception of and attachment to places. The relative success of the management of demographic and cultural changes for individuals and groups depends on that lived experience of change and how perceptions of, and attachments to, the place are changed.

Students should begin by studying the place in which they live or study in order to look at demographic and social changes. They will then put this local place in context in order to understand how regional, national, international and global influences have led to changes in this place. They should then study one further contrasting place, which will develop wider knowledge and understanding about how places change and are shaped. A local place may be a locality, a neighbourhood or a small community, either urban or rural.

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The route to enquiry

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The first 2 (of 6) stages from the suggested route to enquiry - p.6 of the A level specification

Stage	Description
Purpose, identification of a suitable question/aim/hypothesis and developing a focus	Identify appropriate field research questions/aims/hypotheses, based on their knowledge and understanding of relevant aspects of physical and/or human geography. Research the relevant literature sources linked to possible fieldwork opportunities presented by the environment, considering their practicality and relationship to compulsory and optional content. Understand the nature of the current literature research relevant to the focus. This should be clearly and appropriately referenced within the written report.
Designing the fieldwork methodologies, research and selection of appropriate equipment	Consideration of how to observe and record phenomena in the field and to design appropriate data-collection strategies taking account of sampling and the frequency and timing of observation. Demonstrate knowledge and understanding of how to select practical field methodologies (primary) appropriate to their investigation (may include a combination of qualitative and quantitative techniques).

Independent Investigation Overview

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p.68 – A level specification

The independent investigation may relate to human or physical geography or it may integrate them.

The independent investigation must:

- be based on a question or issue defined and developed by the student individually to address aims, questions and/or hypotheses relating to any of the compulsory or optional content
- incorporate field data and/or evidence from field investigations, collected individually or in groups
- draw on the student's own research, including their own field data and, if relevant, secondary data sourced by the student
- require the student independently to contextualise, analyse and summarise findings and data
- involve the individual drawing of conclusions and their communication by means of extended writing and the presentation of relevant data.

A level Geography 2016

Coursework assessment criteria

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p.74 – A level specification

		Purpose of the Independent Investigation (12 marks) (AO1: 4 marks, AO2: 4 marks and AO 3: 4 marks)
Level	**Mark**	**Descriptor**
Level 3	9–12	• Demonstrates accurate and relevant geographical knowledge and understanding of location, geographical theory and comparative context throughout. (AO1) • Applies understanding to find coherent and relevant links between the investigation's context and a broader geographical context. (AO2) • Investigates a wide range of relevant geographical sources in order to identify/obtain accurate geographical information and data that support the investigation; research information is used to construct a justified aim, question or hypothesis that provides an appropriate framework for investigation at a manageable scale; planned enquiry process is logically structured and comprehensive. (AO3)

A level Geography 2016

Coursework assessment criteria

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p.75 – A level specification

		Field Methodologies and Data Collection (10 marks) (AO3: 10 marks)
Level	**Mark**	**Descriptor**
Level 3	8–10	• Chooses appropriate methods to collect a range of data and information relevant to the geographical topic. (A03) • Designs a valid sampling framework explicitly linked and appropriate to the geographical focus being investigated. (AO3) • Considers both frequency and timing of observations. (AO3) • Research planning shows appropriate and relevant understanding of the ethical dimensions of field research methods. (AO3) • Obtains reliable data and information as a result of consistent use of methods with high levels of accuracy/precision. (AO3)

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Chaz Hutton's 'A Map of Every City'

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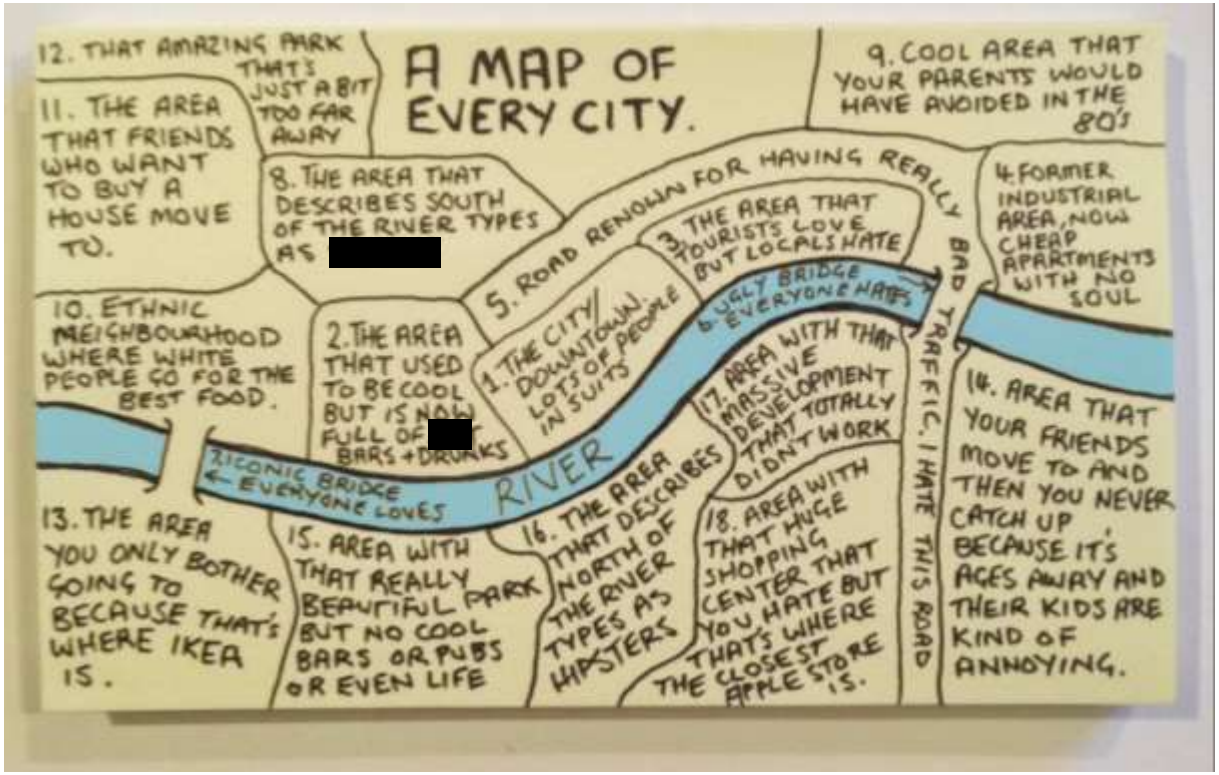
Drawn on a post-it note…



Tweeted by @chazhutton (23rd Jan 2016)

Chaz Hutton: "…it's not actually a map of a city, not in the traditional sense anyway. Rather it's a map of people's experience of living in cities: The changing circumstances of people as they get older and have children, the way 'cool' areas emerge from formerly 'rough' areas and are then invariably compared to the less-cool, traditionally wealthy areas, the kind of areas that an Ikea needs to be built for it to be profitable. All these things are endemic to most large cities, with most of them the outcomes of events situated at some point along the gentrification arc."

Geography review

Representations of place

What can human geographers learn from the different ways in which places are depicted?

GeographyReviewExtras
For a presentation on how to do local-scale fieldwork on place, go to www.hoddereducation.co.uk/geographyreviewextras

What do we mean by representation?

Representation refers to the description or portrayal of someone or something in a particular way. As geographers we learn about places through different representations: through the images that we see, through reading both fiction and non-fiction, through maps, newspapers, media reports, television, films, paintings and so on.

Some representations of place are attempting to communicate something specific about a place or to challenge our view of a place. Examples of these would be an advert for a holiday destination or a place marketing campaign. Most of us, however, learn about places though a broader set of representations.

Liverpool

Even if you have never been to Liverpool you will still 'know' about that city. Most people will be able to identify the city from its skyline or waterfront — the Liver Building and the other great buildings that make up what is now a UNESCO World Heritage site. This architecture represents Liverpool's affluent past — a time when the wealth of Liverpool exceeded that of London (in part due to its participation in the Atlantic slave trade).

Musical associations

Photographs of the Liverpool skyline often include a ferry. This again represents Liverpool's past, particularly the role of musicians in creating a representation of the city in the 1960s. At that time, many people across the world felt that they knew the city, especially places like Penny Lane, a suburban street in Liverpool made famous by a Beatles song.

Changing images

Inevitably, representations of places change over time. In July 1981, riots in Toxteth, an inner-city area of Liverpool, dominated the news. Liverpool was represented as a city that was dangerous and volatile. That summer, riots in other areas such as Brixton (London), Handsworth (Birmingham) and Chapeltown (Leeds) resulted in inner cities being represented as 'disordered landscapes' where young people were uncontrollable and living in 'concrete jungles'.

These representations suggested that the inner city was a 'no-go' area inhabited by an 'animalised' population who threatened the residents in the suburbs. They implied that it was the people who lived in the inner cities who were the 'problem' rather than focusing on the high levels of deprivation that triggered the riots in the first place.

The full picture

We can see how song lyrics, media representations, television programmes and films create different representations of place. All of these contribute to our ways of knowing the city — even if they are not 'accurate' representations of the place.

As geographers, we try to make sense of this complex set of information. Of course, when we analyse representations, we need to look for what is absent as well as what is present. We also need to consider the implications of the way places and people are represented and the ways in which those representations have significance.

Activity

Consider how your local region or city is represented. Think about what those representations might tell you about the place.

GeographyReviewExtras
You can download a pdf of this spread to print as a poster: www.hoddereducation.co.uk/geographyreviewextras

Fiona Smyth is associate dean for teaching, learning and students, Faculty of Humanities, The University of Manchester.

Centrepiece: Representations of place by Fiona Smyth - a printable pdf to use as a poster (Geography Review, Vol.29, No.4, April 2016)

A level Geography 2016

Predicting gentrification through social networking data (Twitter & Foursquare)

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"The Cambridge researchers…used data from approximately 37,000 users and 42,000 venues in London to build a network of Foursquare places and the parallel Twitter social network of visitors, adding up to more than half a million check-ins over a ten-month period."

"We're looking at the social roles and properties of places," said Desislava Hristova from the University's Computer Laboratory, and the study's lead author. "We found that the most socially cohesive and homogenous areas tend to be either very wealthy or very poor, but neighbourhoods with both high social diversity and high deprivation are the ones which are currently undergoing processes of gentrification."

Source: http://www.cam.ac.uk/research/news/predicting-gentrification-through-social-networking-data

The 5 most gentrifying boroughs in London in 2015

A level Geography 2016

Field techniques for use in 'Place'

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Adapted from ideas first seen in John Lyon's Place training 2015

- Place profiling
- Observe... Participate
- Shopping Challenge
- Place check
- Past and futures visioning
- Clone Towns
- Matching models
- Sound-scapes
- Picture the quote
- My place- a different view
- Photo capture
- Urban recall
- Urban detective
- Sign language
- Missing links
- The world in one place
- Drawing with words
- Green Mapping
- 8 way thinking

Source: Field Studies Council Staff Training 2016

A level Geography 2016

Contrasting representations

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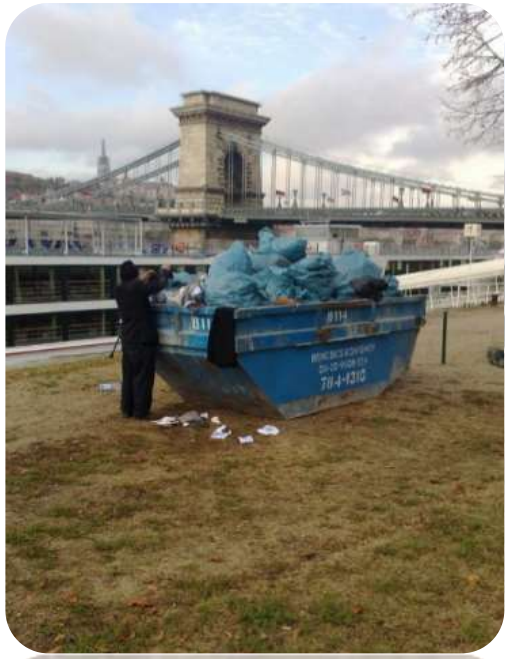
Q Which one is unlikely to feature in a tourist brochure?

Source: Klaus Hermann (forbspiel photography)



Source: Dave Holmes (flickr)

Chain Bridge in Budapest, Hungary

A level Geography 2016

What Makes a Great Place?

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"Placemaking is an instrument to create successful public spaces by the community itself. When it's digital and combines the ideas of 'Design for all' it can be used on a wide scale in cities that deal with ageing to make their places senior-proof"

Source: Written by an adviser of JSO (Rotterdam) who specialises in public space, co-creation and dialogue. This is an extract from an idea submitted to http://ideas.chest-project.eu/

A level Geography 2016

A Tale of Four Cities

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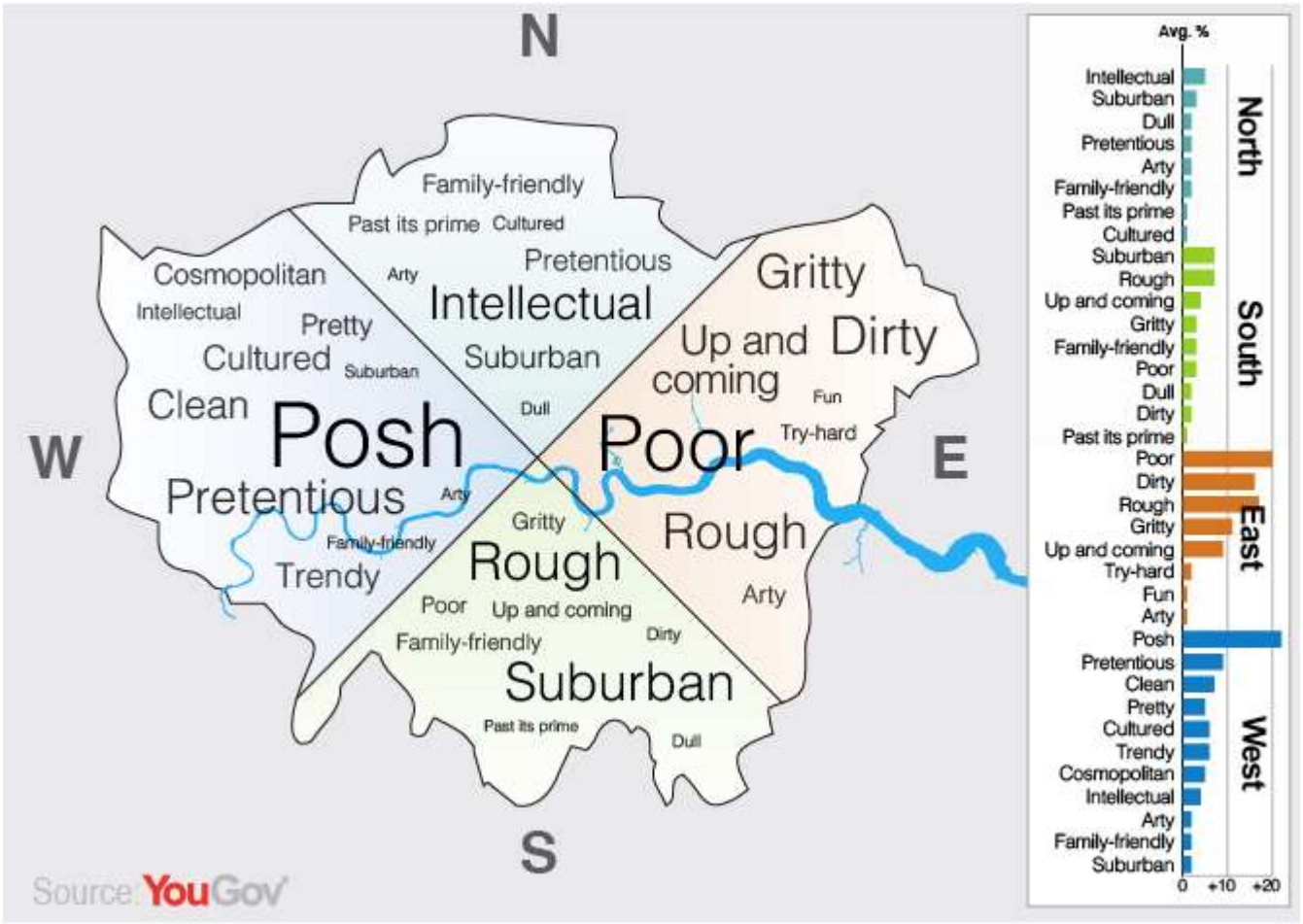

"A new survey of Londoners reveals the city's regional stereotypes: the West is 'posh', the East is 'poor', the South is 'rough' and the North is 'intellectual'"

by William Jordan - Elections editor @williamjordann (YouGov.co.uk, Jan 21st 2014)

A level Geography 2016

Use of photographic evidence

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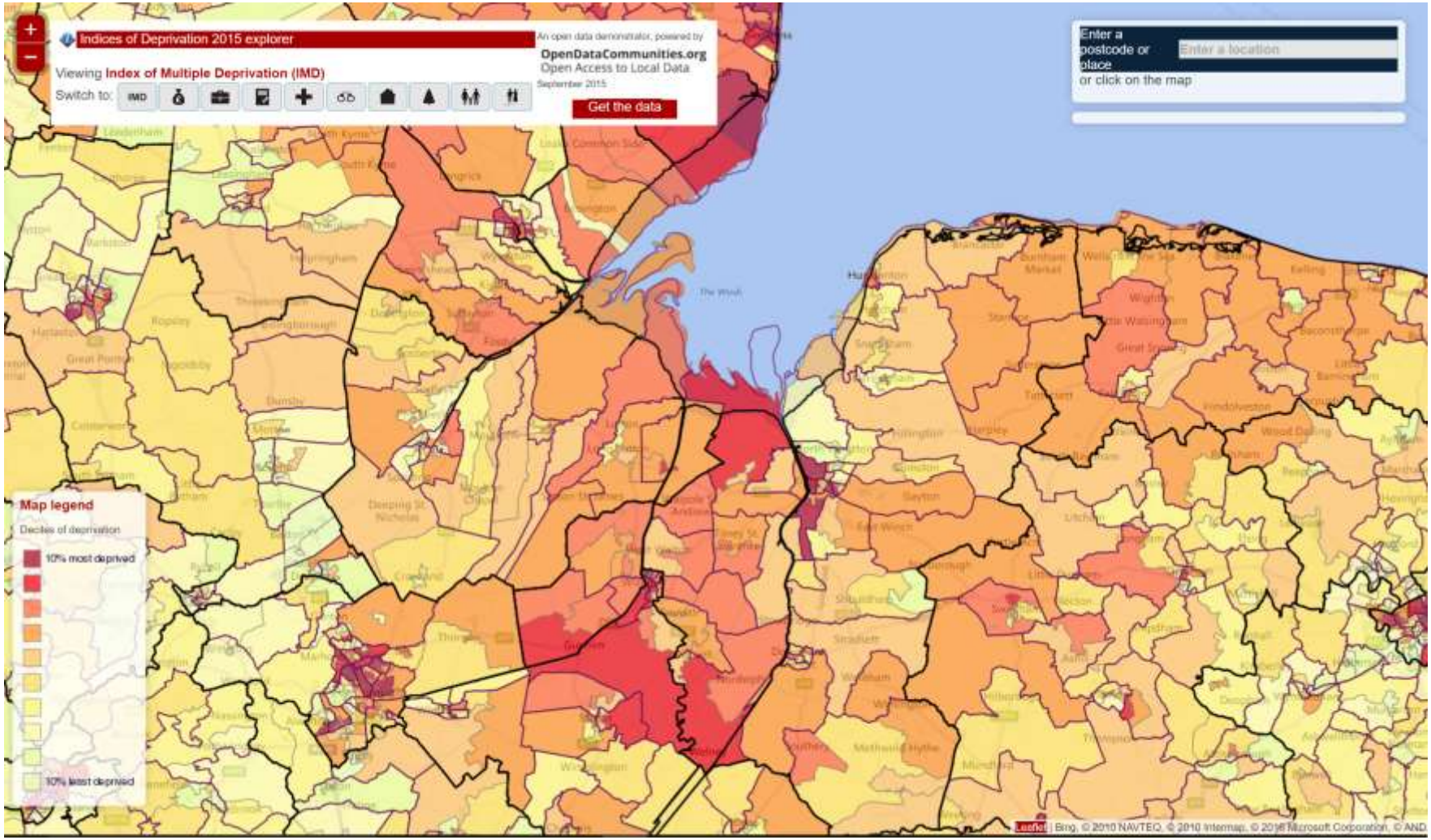
by Dave Holmes - a huge number of his photos can be found at his flickr account, arranged into topic-specific albums

Open Data

Source: Screen capture from Indices of Deprivation 2015 explorer - OpenDataCommunities.org



A level Geography 2016

Heritage & Regeneration

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"The Sheffield that rolls alongside The Full Monty's opening credits is a city of industry and clean air, hard work and culture, discotheques and football. "Thanks to steel," the voiceover tells us, "Sheffield really is a city on the move.""

Cities

Cities in culture: has Sheffield finally shaken off its Full Monty image?

In 1997, when Gaz and his mates 'got their cloth off', Sheffield was still struggling with factory closures and job losses. But what do the iconic Full Monty locations look like today - and what can they tell us about the city's fortunes?

By
Ellie Violet Bramley
(The Guardian,
2nd Feb 2015)

A level Geography 2016

Connecting Places

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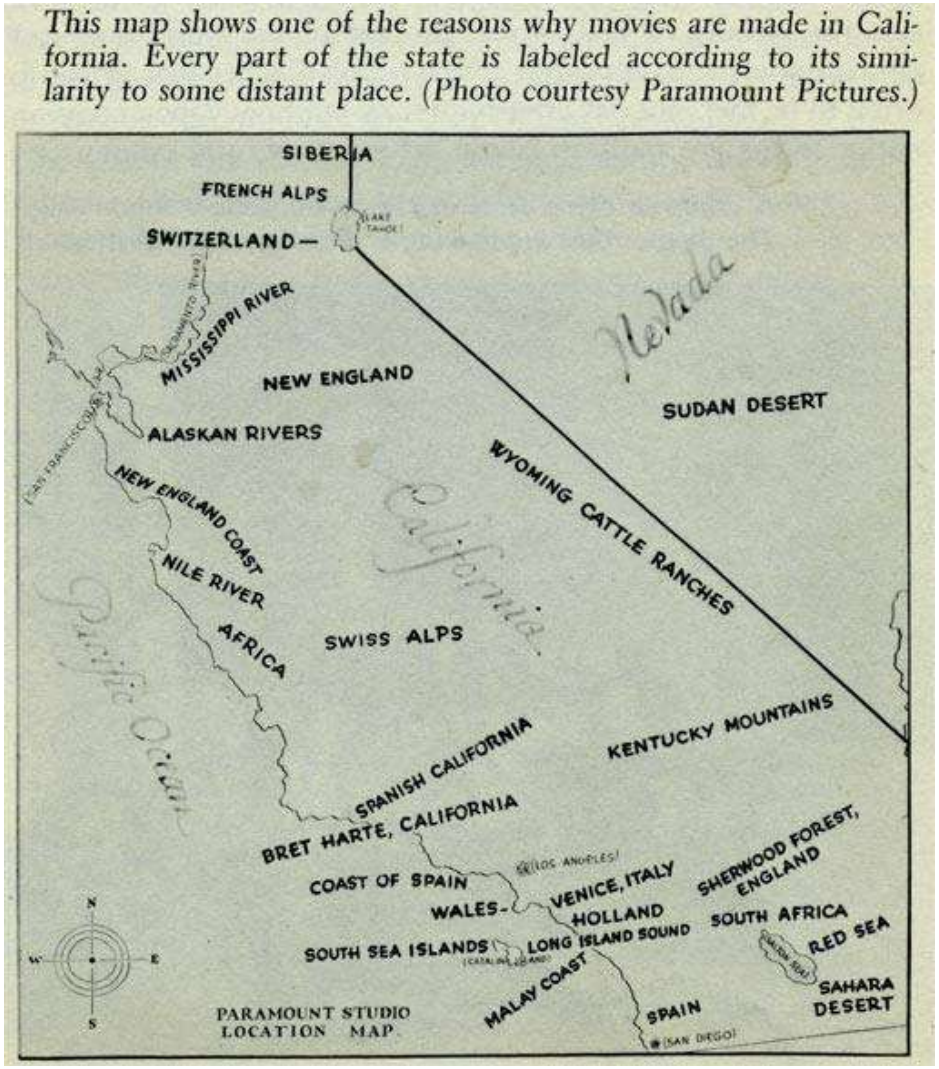

Source: Paramount Studio location map from 1927, showing potential shooting locations in Southern California.

Published in 'The American Film Industry' (1976) by Tino Balio

A level Geography 2016

Sense of Place

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A Global Sense of Place – by Doreen Massey

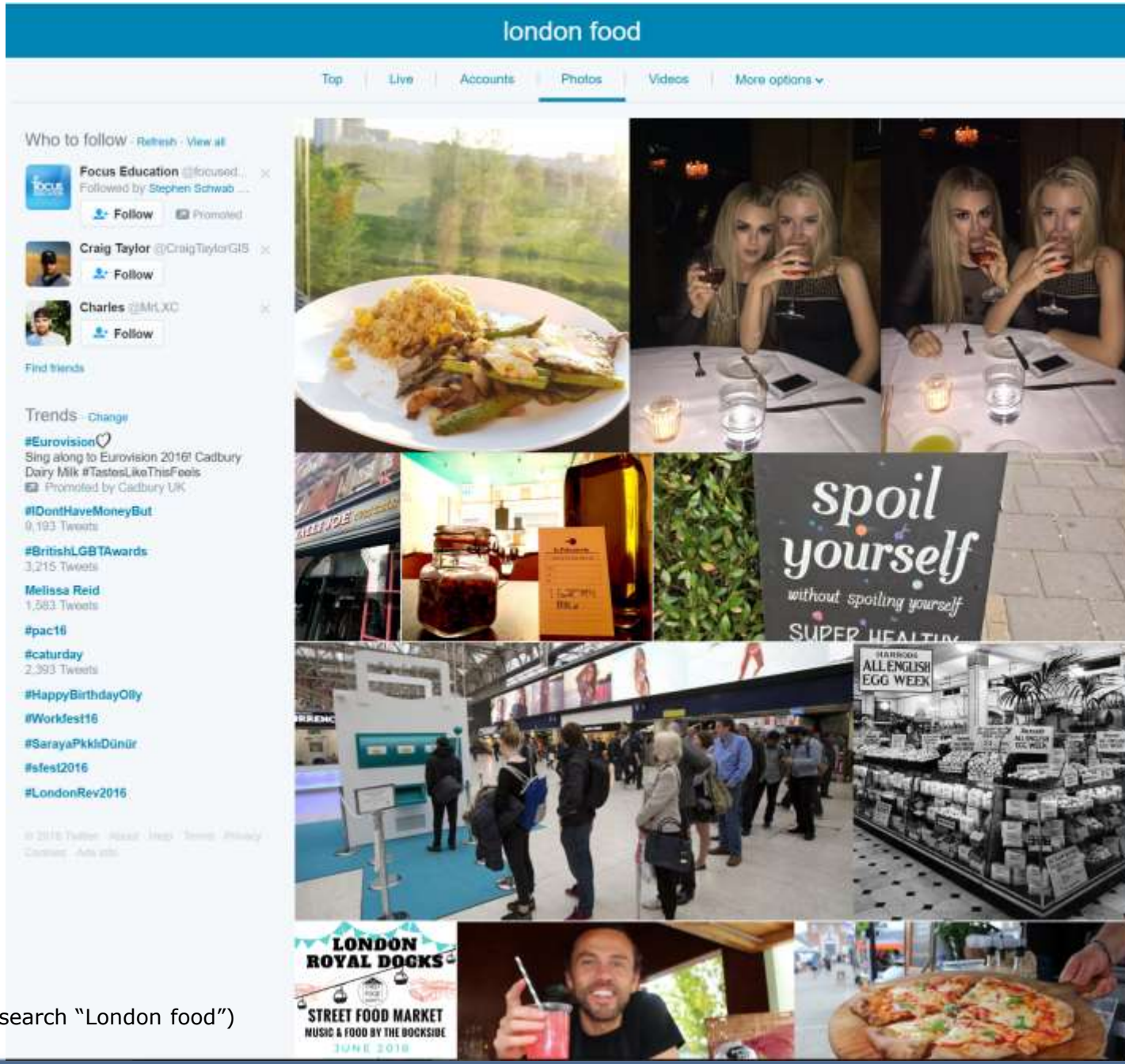
From Space, Place and Gender. Minneapolis : University of Minnesota Press, 1994.

Take, for instance, a walk down Kilburn High Road, my local shopping centre. It is a pretty ordinary place, north-west of the centre of London. Under the railway bridge the newspaper stand sells papers from every county of what my neighbours, many of whom come from there, still often call the Irish Free State. The postboxes down the High Road, and many an empty space on a wall, are adorned with the letters IRA. Other available spaces are plastered this week with posters for a special meeting in remembrance: Ten Years after the Hunger Strike. At the local theatre Eamon Morrissey has a one-man show; the National Club has the Wolfe Tones on, and at the Black Lion there's Finnegan's Wake. In two shops I notice this week's lottery ticket winners: in one the name is Teresa Gleeson, in the other, Chouman Hassan.

A level Geography 2016

Sense of Place

Research using social media or search engines like Google can provide an insight into how people represent or experience 'place'…



Source: twitter.com (search "London food")

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Google Maps

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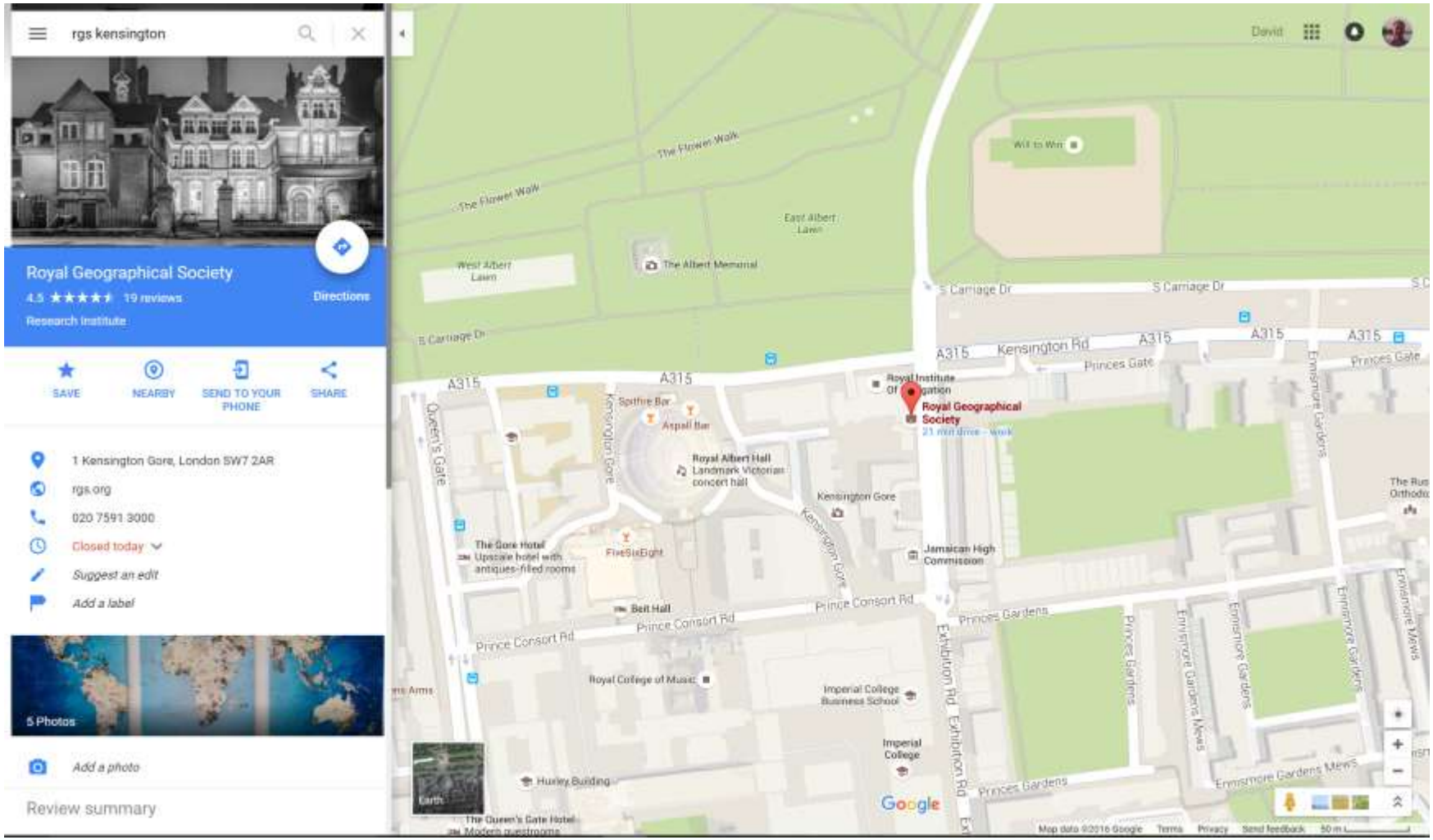

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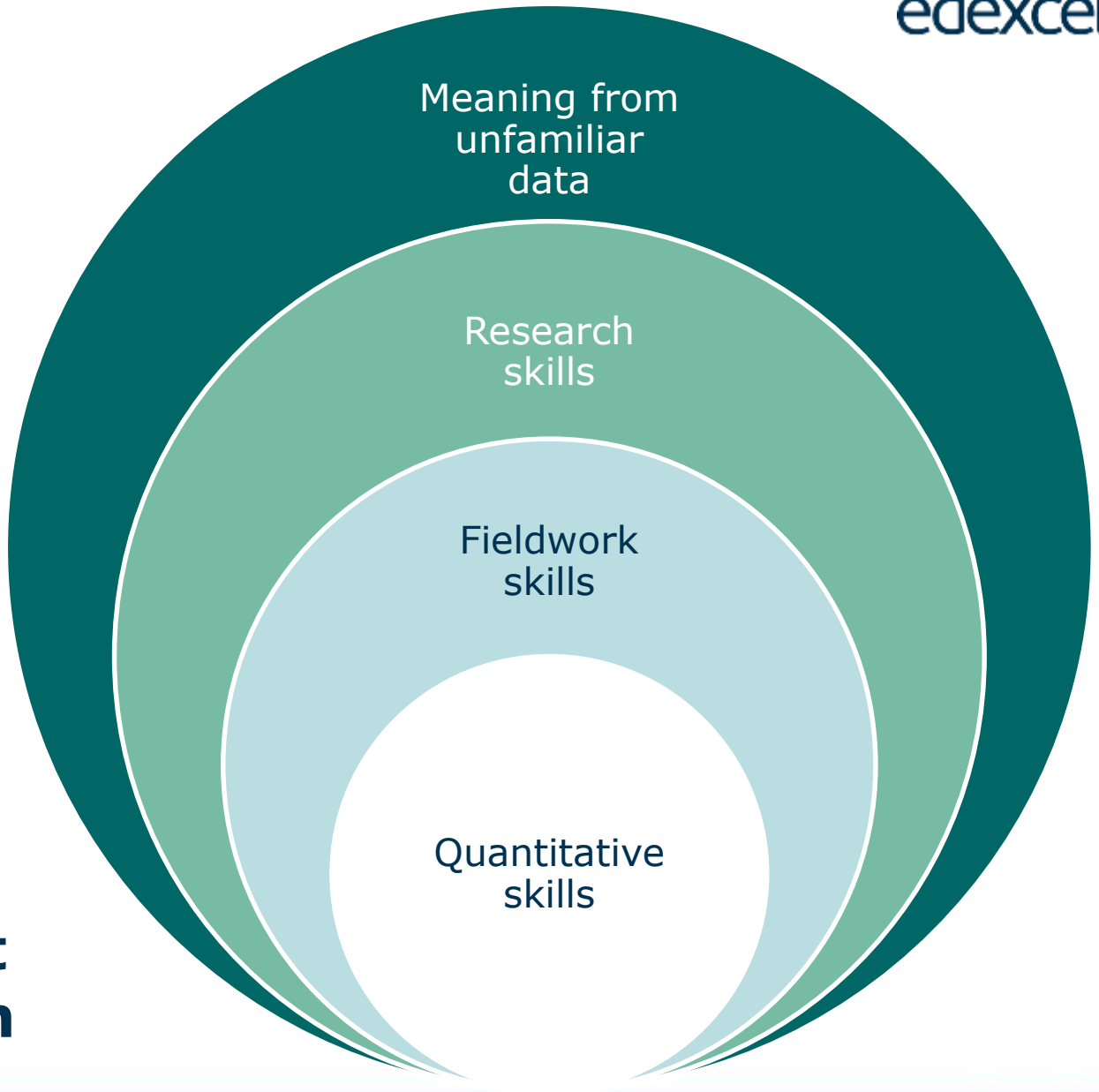
Overlap between 'data decision-making' and the Independent Investigation



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Independent Investigation Form

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(Appendix 5, p.96)

Candidate name	**Candidate number**	**Examination Series**
Centre name		**Centre number**
Investigation title	**How the title links to specification content**	
Planned investigation hypothesis or question/sub-questions		
Investigation focus – indication of how the enquiry will enable the candidate to address their investigation title and explore their theme in relation to the chosen geographical area.		
Planned methodology – indication of qualitative and/or quantitative techniques including primary and, if relevant, secondary data collection techniques, indication of the planned sampling strategy or strategies.		**Individual/Group data collection (Delete as appropriate)**
Teacher's approval and comments		
Teacher signature	**Date**	

A level Geography 2016

What have we learnt?

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Session 4

Data Analysis & Statistics

1:55 – 2:40pm

Simon Ward

Head of FSC London Region

simon.lr@field-studies-council.org

GCSE and A level Geography 2016

Session outline

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1. Reliable and Valid Data
2. Scatter Graphs & Correlations
3. Spearman Rank
4. Frequency Diagrams, Bar Charts and Histograms
5. t-test
6. How true are the patterns we see in quantitative data?

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Data Reliability & Validity

Data collected on fieldwork at GCSE and A-level is often collected in a short timescale with a relatively small data set

Need to ensure we identify patterns that are possibly hidden and not make general assumptions about the data

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What is Reliable and Valid Data?

Reliable Data – the data collected is repeatable and variation between results is small. If you were to repeat the study you should get similar findings

Valid Data – The confidence in a set of results and the conclusions drawn from them. Results are valid if they measure what they are supposed to, and if they are *precise, accurate and reliable*

edexcel

Accurate & Precise Data

Accurate Data – How close the data collected is to the actual/real value

Precise Data – The closeness of repeated measurements. They do not have to be accurate!

edexcel

How can we assess if the data is valid and reliable?

A-level Spec Requirement:
Descriptive measures of difference and association from the following statistical tests: t-tests, Spearman's rank, chi-squared; inferential statistics and the foundations of relational statistics, including measures of correlation and lines of best fit on a scatter plot.

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Patterns in data

Relationship
Spearman
Rank

Difference
T-test

Association
Chi-Squared

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GCSE & A-level Geography

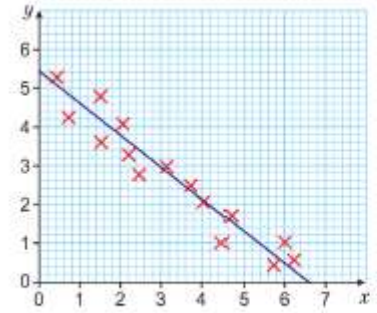

Figure 16 Strong correlation

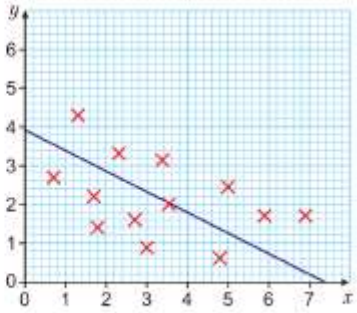

Figure 17 Weak correlation

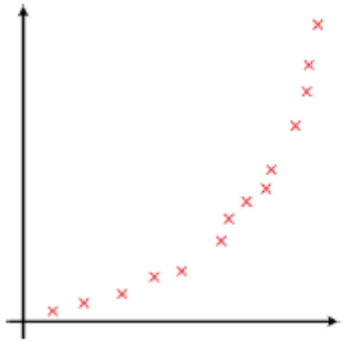

Figure 18 Scatter graph showing a possible non-linear relationship

Scatter Graphs

- Correlation & Line of Best Fit
- Correlation does imply causation!
- Students can find hard to interpret

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GCSE & A-level Geography

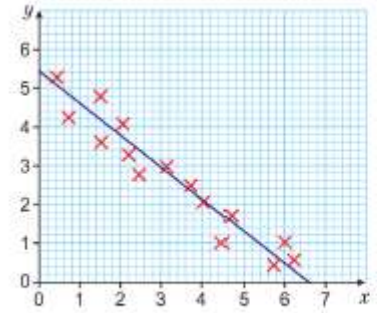


Figure 16 Strong correlation

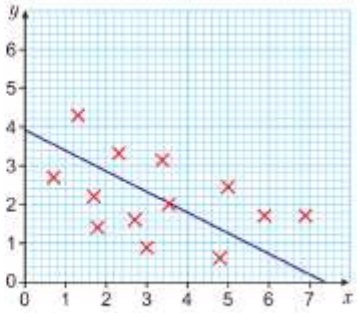


Figure 17 Weak correlation

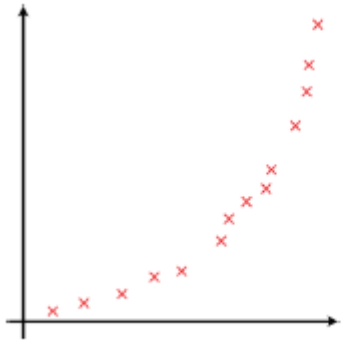
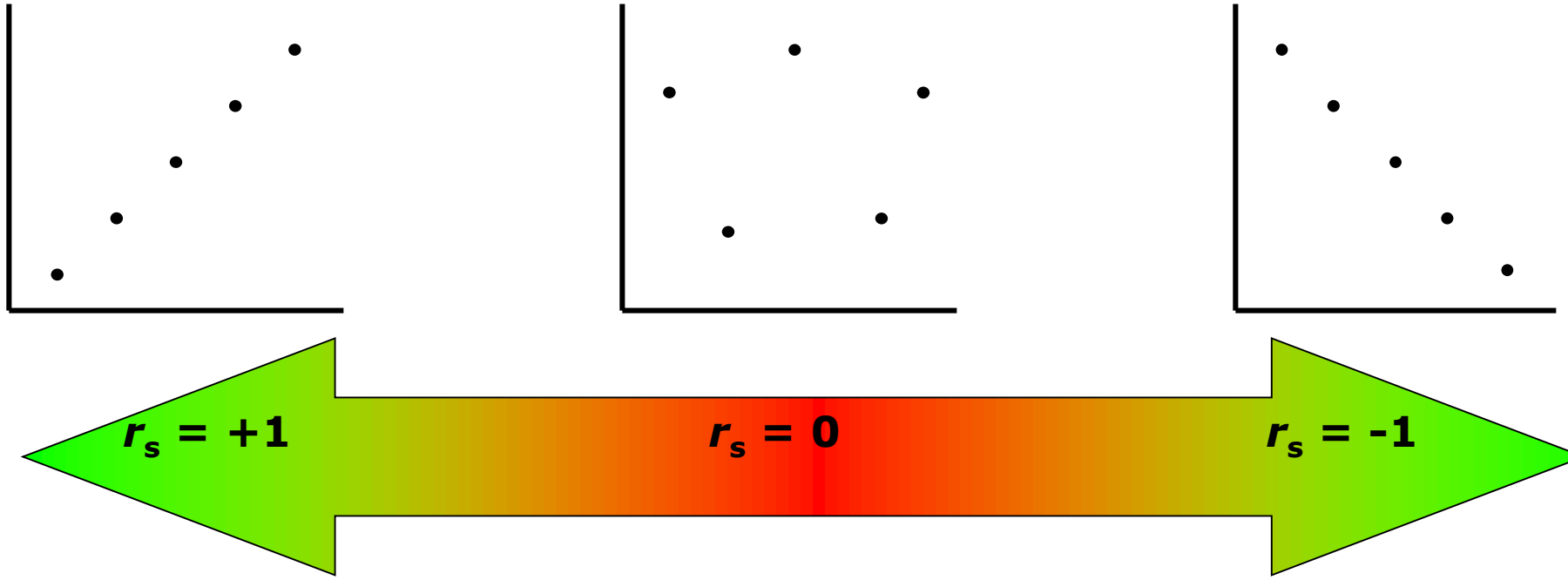


Figure 18 Scatter graph showing a possible non-linear relationship

Scatter Graphs

- Correlation & Line of Best Fit
- Correlation does imply causation!
- Students can find hard to interpret

Spearman Rank



$$r_s = 1 - \frac{6\Sigma D^2}{n^3 - n}$$

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GCSE & A-level Geography

GCSE and A level Geography 2016

Geography mark	0–10	11–20	21–30	31–40	41–50
Frequency	4	13	17	19	7

Figure 6 Frequency table (grouped discrete, quantitative data)

Distance (d metres)	Frequency
$10 \leq d < 20$	2
$20 \leq d < 30$	6
$30 \leq d < 40$	15
$40 \leq d < 50$	20
$50 \leq d < 60$	4

Figure 7 Frequency table (grouped continuous data)

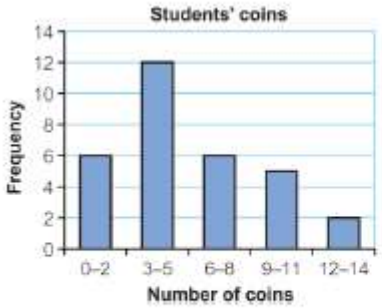

Figure 8 Frequency diagram (discrete, quantitative data)

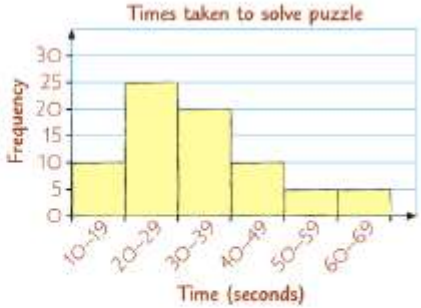

Figure 9 Frequency diagram (continuous quantitative data)

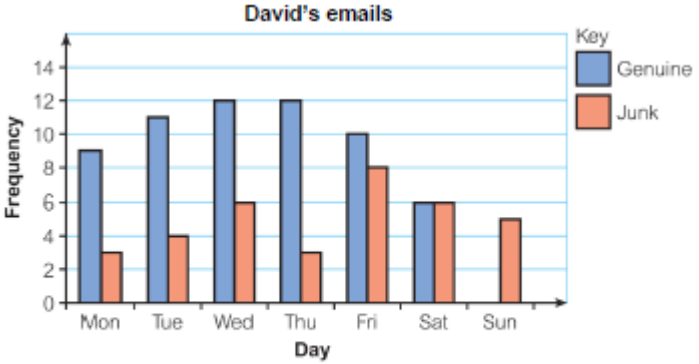

Figure 10 Comparative bar chart (discrete, qualitative data)

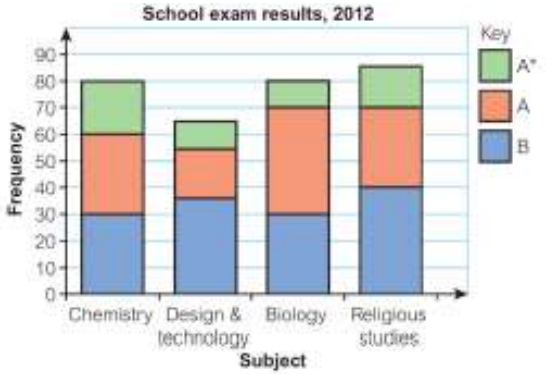

Figure 11 Compound bar chart (discrete, quantitative data)

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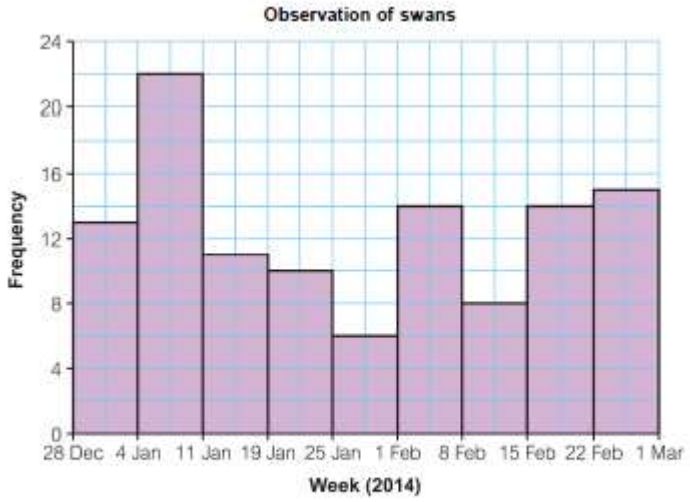


Figure 12 Histogram with equal width bars/groups

Key point 12

In a **histogram** the area of the bar represents the frequency. The height of each bar is the frequency density.

$$\text{Frequency density} = \frac{\text{frequency}}{\text{class width}}$$

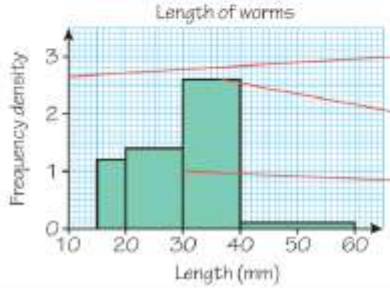
Example 4

The lengths of 48 worms are recorded in this table.

Length, x (mm)	$15 < x \leqslant 20$	$20 < x \leqslant 30$	$30 < x \leqslant 40$	$40 < x \leqslant 60$
Frequency	6	14	26	2

Draw a histogram to display this data.

$6 \div 5 = 1.2$, $14 \div 10 = 1.4$, $26 \div 10 = 2.6$, $2 \div 20 = 0.1$ — Work out the frequency density for each class



Label the y-axis 'Frequency density'.

The height of each bar is the frequency density for each class.

Draw the bars with no gaps between them.

Source: *Edexcel GCSE (9-1) Mathematics Higher* student book

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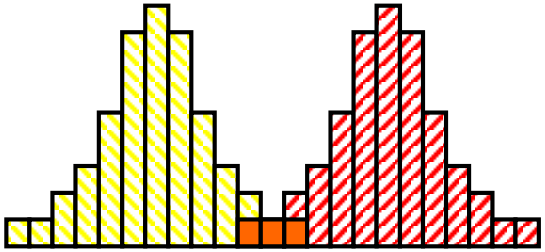
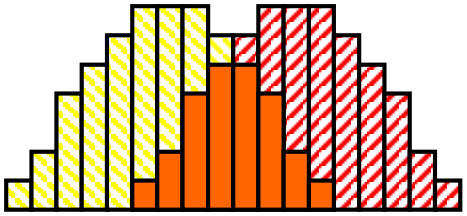
t-test

Tally chart for clast size		
Size Class (cm)	East Shore	West Shore
1.5-1.9		
2.0-2.4	I	IIII
2.5-2.9	III	III
3.0-3.4	IIII	IIIIII
3.5-3.9	IIIIII	IIIIIIIIII
4.0-4.4	IIIIIIIIII	IIIIIIIIII
4.5-4.9	IIIIIIIIII	IIIIIIIIII
5.0-5.4	IIIIII	IIIII
5.5-5.9	IIIII	III
6.0-6.4	II	I
6.4-6.9	I	
Mean	4.46	3.46

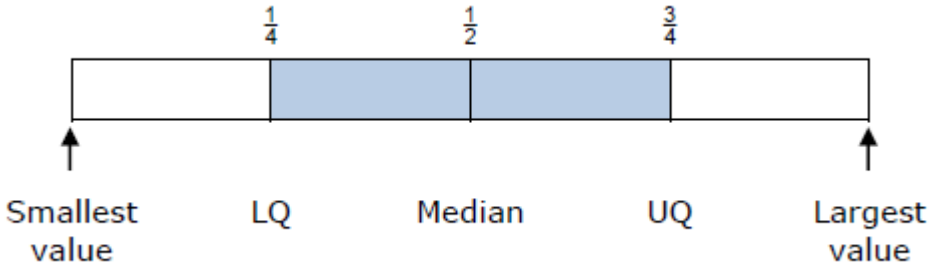


Little overlap - seems obvious there is a difference

Lots of overlap - seems less likely there is a difference



t-test



Interquartile Range

A box and whisker plot can help identify a normal distribution

Ideally data should be normally distributed in a t–test - collect more data / recognise may skew results (evaluation)

How true/reliable are your conclusions?

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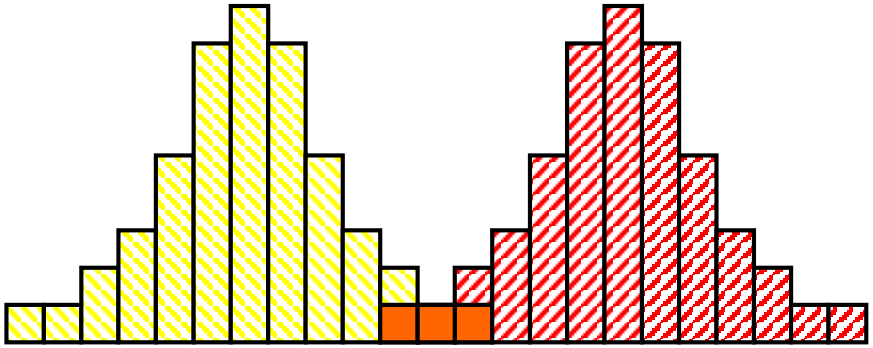
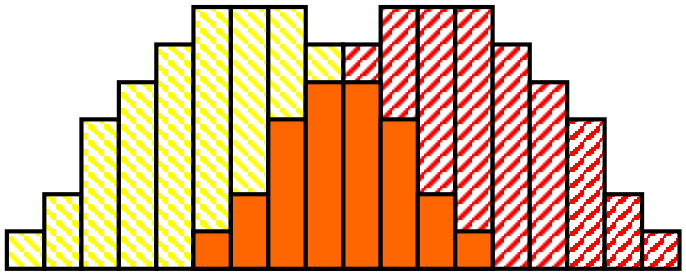
t-test





$$t = \frac{|\bar{x}_1 - \bar{x}_2|}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

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What can be concluded?

Do results using quantitative data tell us the truth?

- Smaller data sets may be heavily affected by anomalies and patterns distorted
- Causal relationships may be shown but what is the underlying theory?
- Statistics give us a lot more support in making conclusion and evaluating

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Session 5

Tackling units through the carbon cycle

11:40 – 12:20pm

Martin Evans

University of Manchester

Why are data skills relevant?

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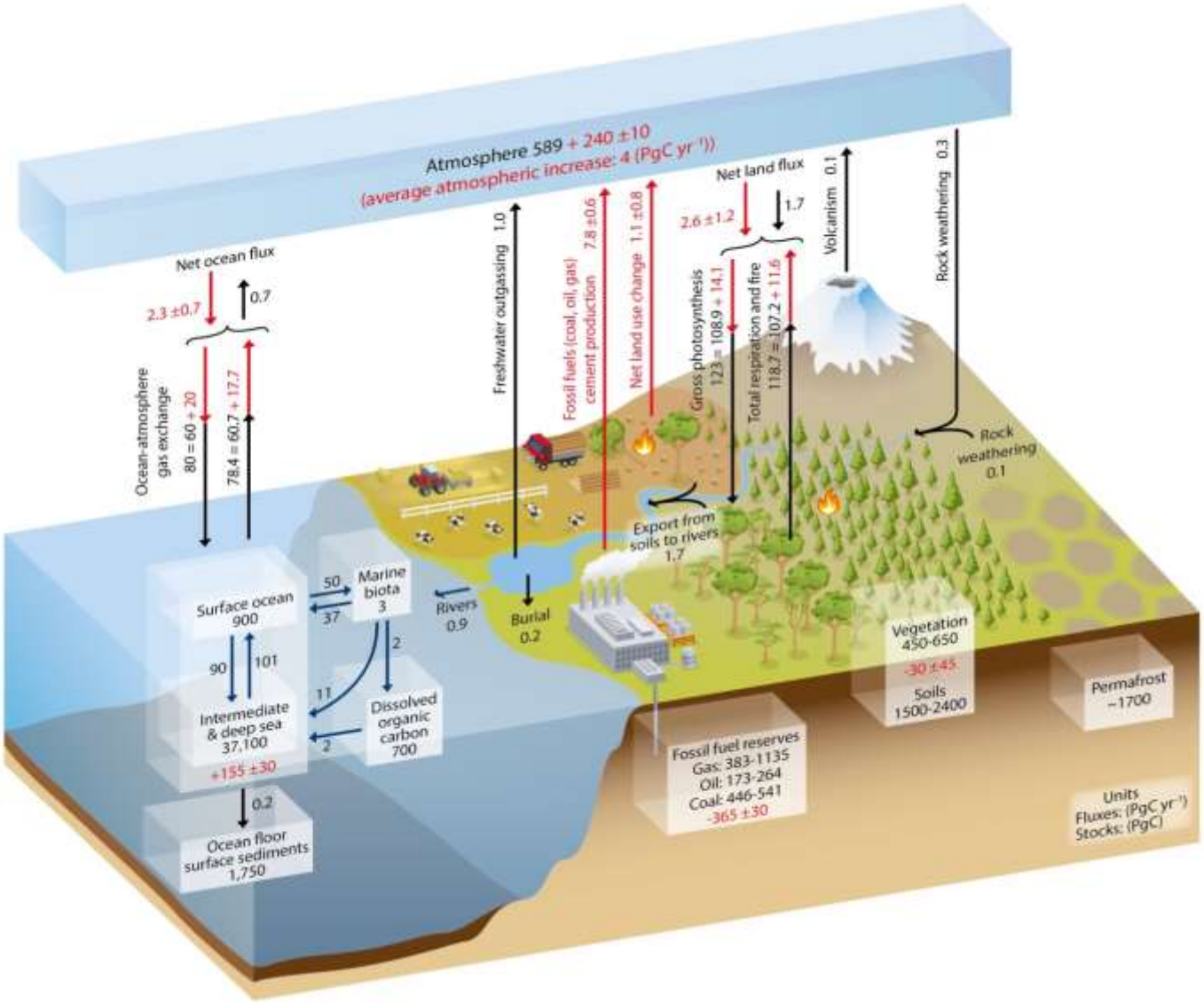
- Units are commonly an area where students struggle.
- In order to make meaningful quantitative comparisons between places students need to be comfortable working with comparable units and with simple geospatial concepts.
- Both geospatial data and unit conversions are specified as skills within the new A level
- In the water and carbon cycle units a key concept is the ability of a biogeochemical cycles approach to link across scales. This requires and understanding of relevant units and opens up the potential to understand local fieldwork in the context of critical global issues
- In this workshop we will explore ways in which working with units and geospatial data can be introduced in the context of carbon cycling.

The Global Carbon Cycle



IPCC, 2013: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Stocker, T.F. et al. (eds.). Cambridge University Press, Cambridge. 1535 pp. *For full details of the estimates underlying this figure see https://www.ipcc.ch/report/ar5/wg1/*

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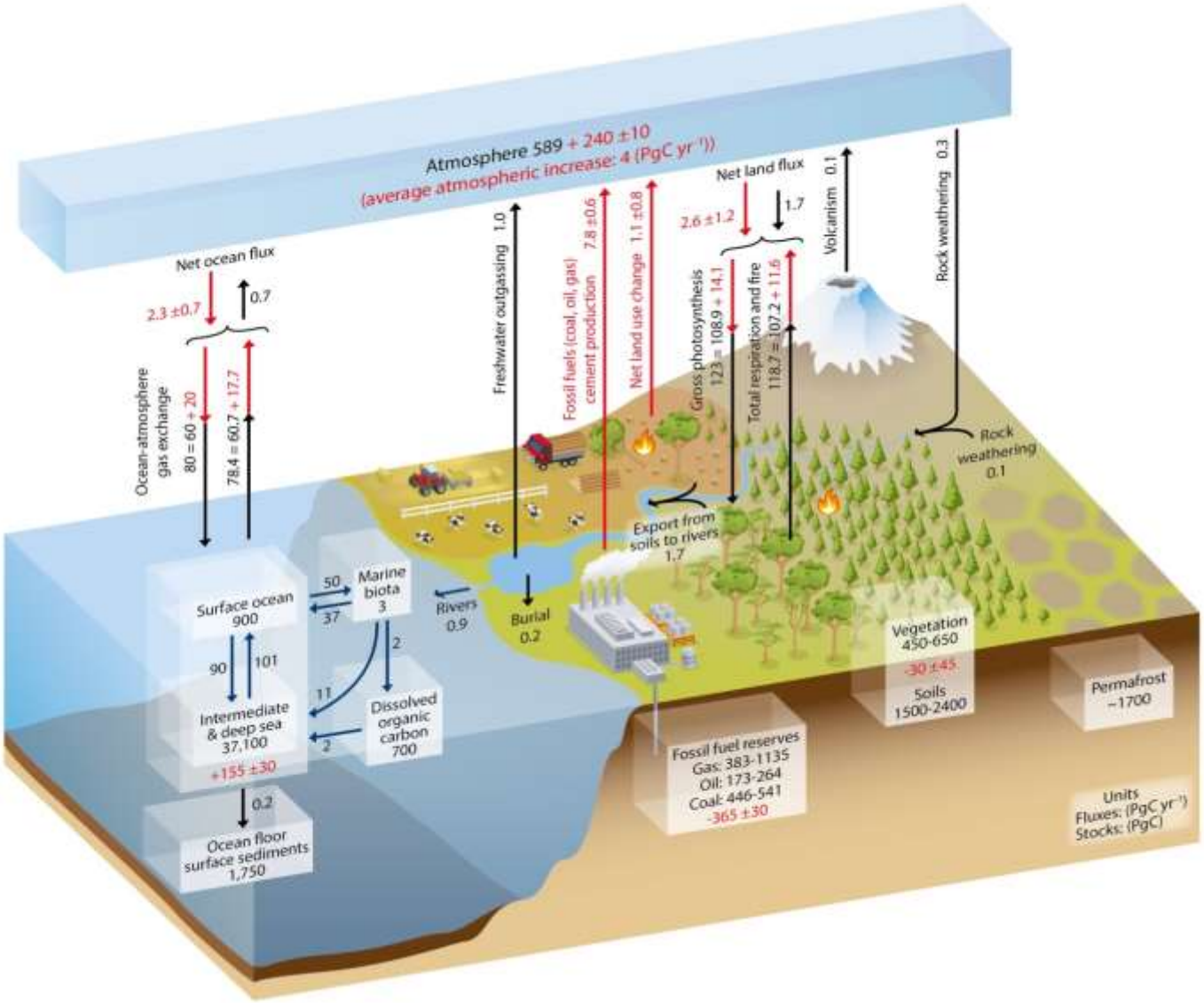
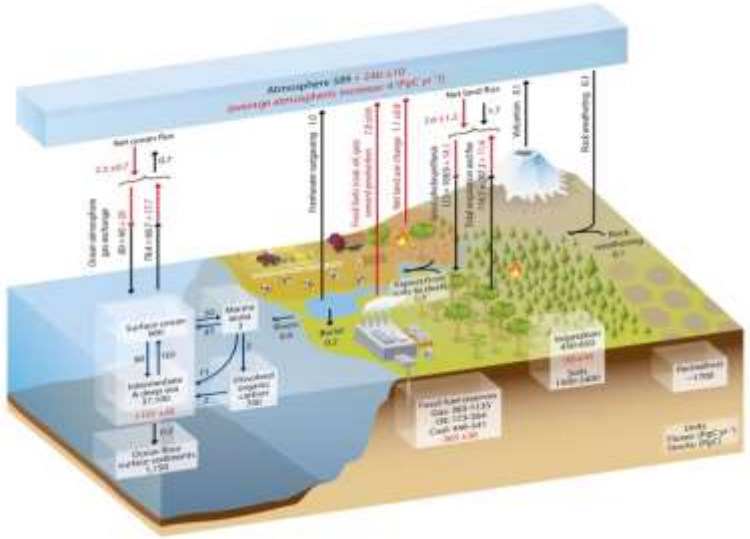


Where is the geography in this diagram?

Carbon cycle units

- Units of stock = Pg C = Petagrammes of carbon = 10^{15} g C = 10^{9} tonnes C
- Units of flux = Pg C yr^{-1} (= Pg C /yr)
- These global units have no geography
- Earths land surface area = 148326000 km^2
- So a net ecosystem exchange (NEE) flux to the terrestrial biosphere of 4.3 x 10^{9} t C yr^{-1} = 28.99 t C km^{-2}
- This areal unit is fundamentally geographical and allows comparison between different spatial scales and different land use/land covers etc.



Important note: sometimes carbon fluxes are reported as mass of CO_2 mass of C is 12/44 x mass CO_2

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Measuring Carbon Stock

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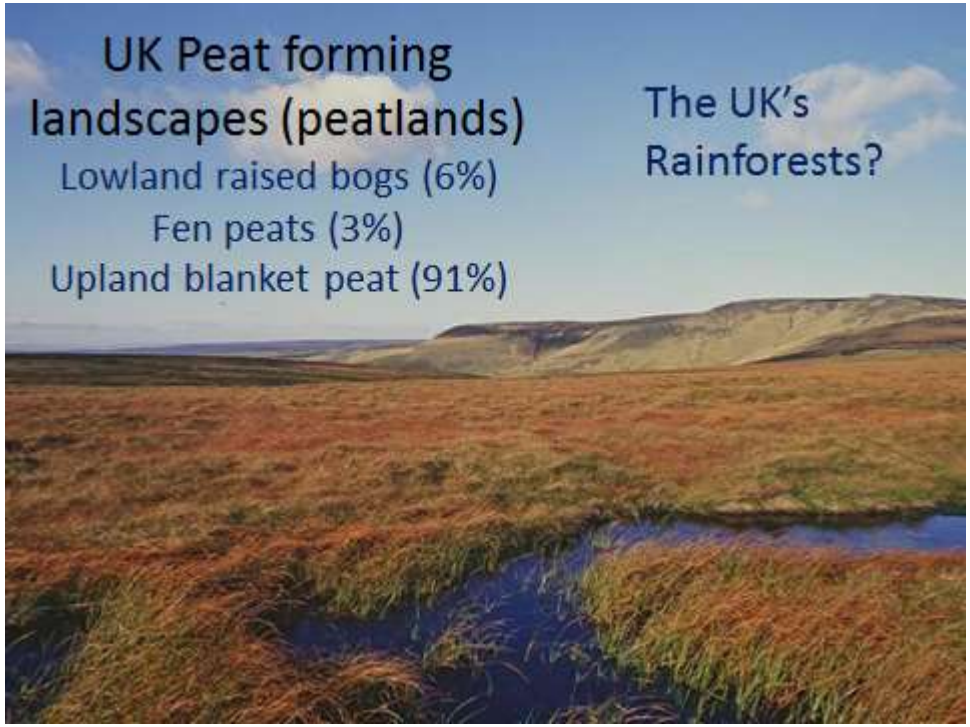
- UK peatlands store 5.1 billion tonnes of carbon. This is half of all UK soil carbon and an order of magnitude more than in vegetation…Peatlands are the UK's rainforests!

- We can measure these stocks by working out how much peat is present at a site (measuring peat depths) and converting to carbon content.



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Measuring Carbon Stock

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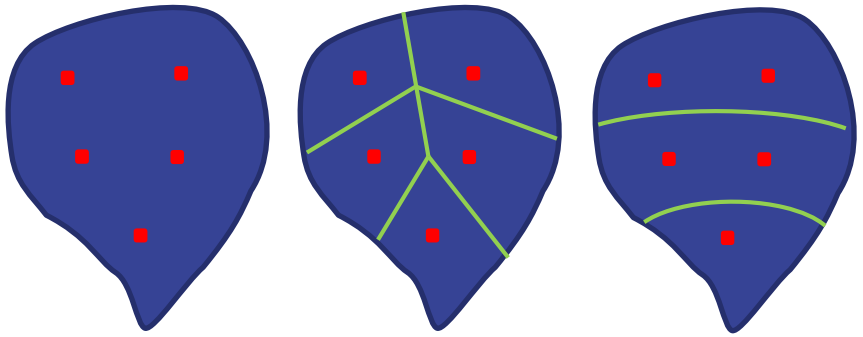
- We can measure peat depth by probing (m)
- If we multiply depth (m) by area we have a volume (m^3)
- We need to choose an appropriate way of scaling up multiple measurements (Geospatial averaging)
- Peat density (dry weight/wet volume) is typically close to 0.15 (0.1-0.2) g/m^3



Peat depth measurements Thiessen Polygons Depth contours

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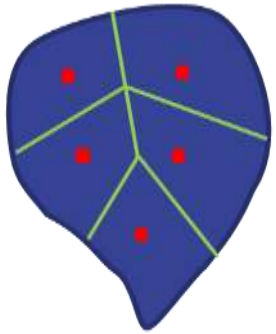
Example calculation

Measured peat depth (m)	Area of Thiessen polygon drawn around the measurement point (m^2)	Peat Volume (m^3)	Peat Mass (derived from assumed density of 0.15 tm^{-3})
2.1	95	199.5	29.925
1.8	58	104.4	15.66
2.4	78	187.2	28.08
3.6	92	331.2	49.68
1.3	121	157.3	23.595
Totals	**444**	**979.6**	**146.94**



Peat typically has a carbon content close to 50% so 146.94 t of dry mass is equivalent to 73.47 tC
Across an area of 444 m2 this is 0.165 t C m^{-2}

This is an areal unit of carbon stock which would allow comparisons between areas of peatland or for example between a local forest and a local peatland

From stock to flux

- Many UK peatlands have known basal dates dated by radiocarbon dating
- A typical peat basal age might be 6000 BP
- If we divide areal accumulation rate (gC m^{-2}) by the period of accumulation (yr) we get flux (carbon sequestration rate) in gC m^{-2} yr^{-1}
- Note gC m-2 yr-1 are numerically equivalent to t C km-2 yr-1

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Dissolved carbon flux from peatlands

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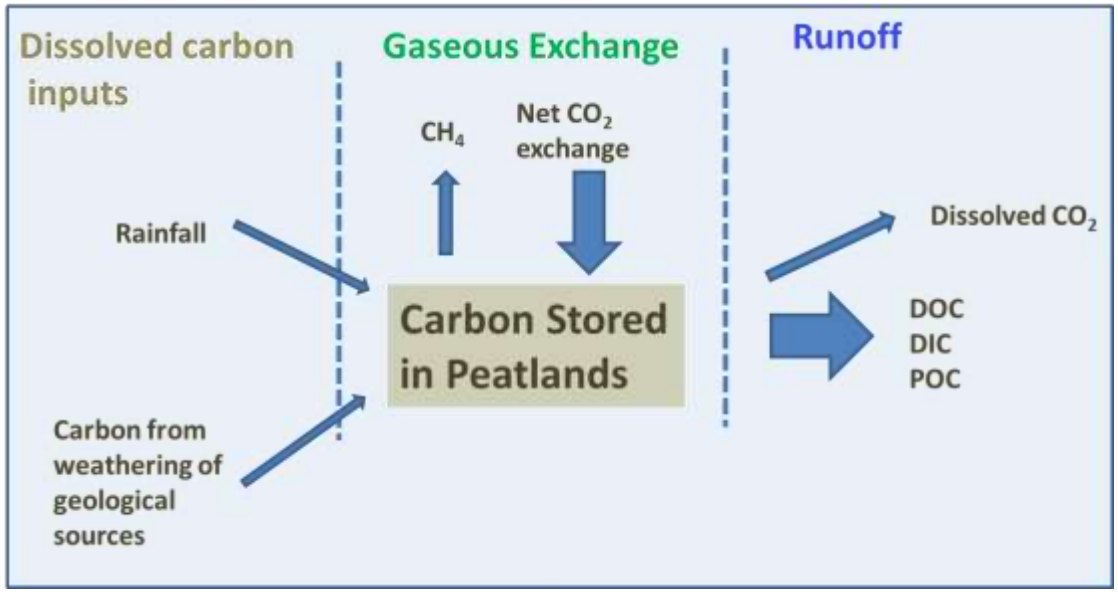
Pathway	Flux gC m^{-2} yr^{-1}
Net Ecosystem Exchange	-55
Dissolved organic carbon (DOC)	9.4
Particulate organic carbon (POC)	19.9
Dissolved inorganic carbon (DIC)	5.9
CH_4	7.1
Rainfall + Weathering	-6.0
Balance	**-18.7**

Typical peatland carbon balance after Worrall et al. 2003



Dissolved carbon flux in Rivers

- Flux = Discharge x Concentration
- We can measure Dissolved organic carbon content by colorimetry
- We can therefore estimate the flux of DOC from a river system but we have to pay careful attention to units!

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A Worked Example

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Example Data	Value	Units
Catchment Area	5	Km^2
Mean Stream Velocity	0.7	$m\ s^{-1}$
Stream X-sect area	0.8	m^2
DOC concentration	15	$mg\ l^{-1}$

Key water cycle calculation

Quantity	Calculated how	Value	Units
Discharge (Q)	V ($m\ s^{-1}$) x A (m^2)	0.56	$m^3\ s^{-1}$
DOC concentration	[DOC] ($mg\ l^{-1}$) x 1000	15000	$mg\ m^3$
DOC flux	[DOC] ($mg\ m^{-3}$) x Q ($m^3\ s^{-1}$)	8400	$mg\ s^{-1}$
DOC flux (g)	DOC flux ($mg\ s^{-1}$) / 1000	8.4	$g\ s^{-1}$
DOC flux daily	DOC flux ($g\ s^{-1}$) x 86400	34560	g
Daily DOC flux areal	DOC flux daily (g) / catchment area (km^2)	6912	$g\ km^2$
DOC flux areal	Daily DOC areal ($g\ km^{-2}$) /1000000	0.0069	$t\ km^2\ d^{-1}$

Convert mg to g

No. seconds in a day

Now an areal (geographical) unit

..almost t C $km^{-2}\ yr^{-1}$ need more data for this

Summing Up

- Understanding the carbon cycle involves some understanding of the units
- The carbon and water cycle unit are a good place to consider unit conversions and perhaps some geospatial data
- By using geographically relevant units (per unit area) we can compare across scales from the NEA in the school field to the global carbon cycle
- The challenges students face with units are largely conceptual not mathematical.

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Data toolkit & final questions

3:30 – 4:00pm

David Holmes

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Well, I hope its been fun!

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20 cognitive biases that screw up your decisions

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2. Availability heuristic.

People **overestimate the importance** of information that is available to them. A person might argue that smoking is not unhealthy because they know someone who lived to 100 and smoked three packs a day.

6. Clustering illusion.

This is the tendency to **see patterns in random events**. It is key to various gambling fallacies, like the idea that red is more or less likely to turn up on a roulette table after a string of reds.

7. Confirmation bias.

We tend to listen only to information that confirms our **preconceptions** — one of the many reasons it's so hard to have an intelligent conversation about climate change.

15. Recency.

The tendency to weigh the **latest information** more heavily than older data. Investors often think the market will always look the way it looks today and make unwise decisions.

SOURCES: Brain Biases; Ethics Unwrapped; Explorable; Harvard Magazine; HowStuffWorks; LearnVest; Outcome bias in decision evaluation, Journal of Personality and Social Psychology; Psychology Today; The Bias Blind Spot: Perceptions of Bias in Self Versus Others, Personality and Social Psychology Bulletin; The Cognitive Effects of Mass Communication, Theory and Research in Mass Communications; The less-is-more effect: Predictions and tests, Judgment and Decision Making; The New York Times; The Wall Street Journal; Wikipedia; You Are Not So Smart; ZhurnalyWiki

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Any questions?