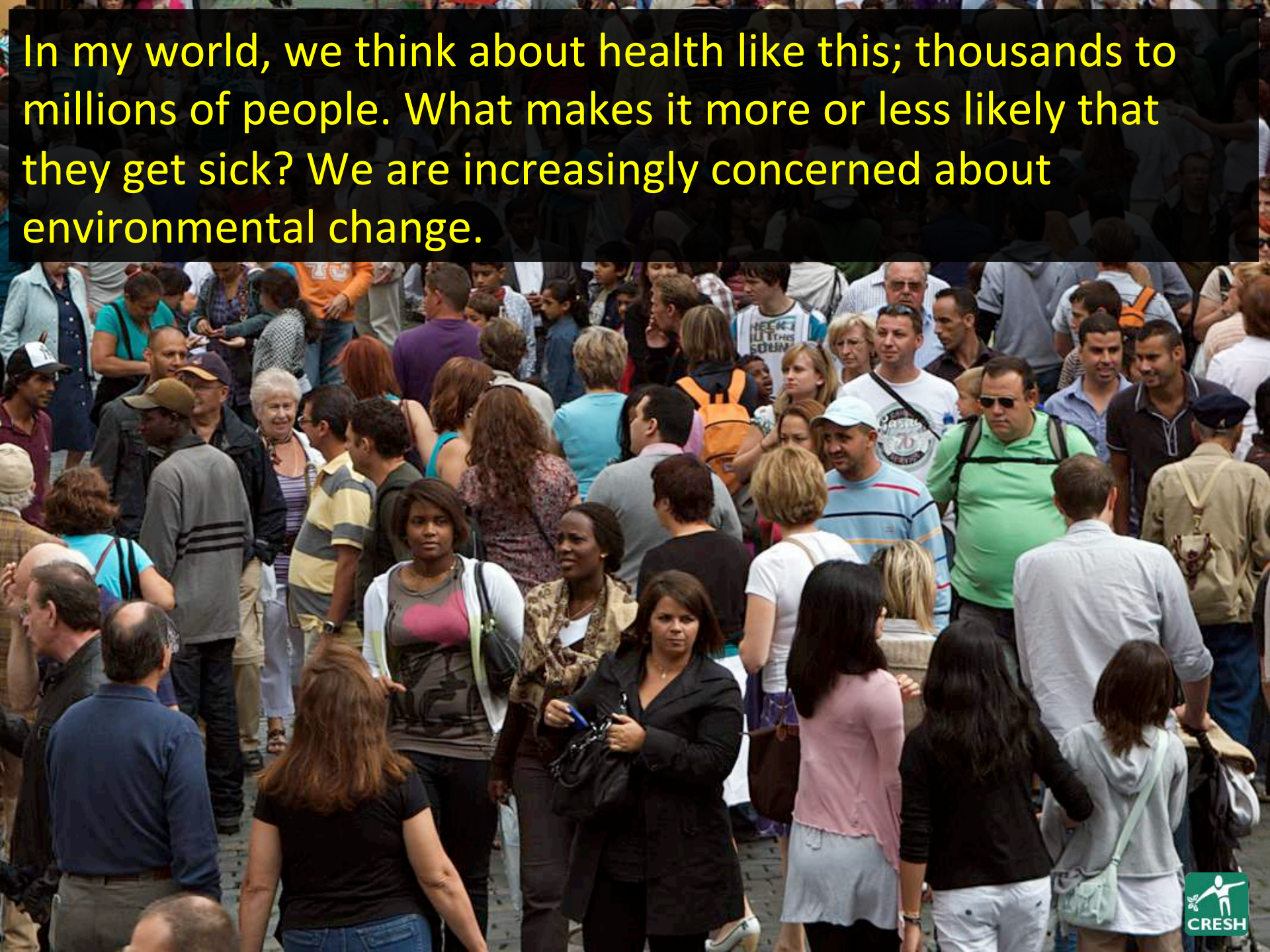
University of Glasgow | Institute of Health & Wellbeing

CRESH
Centre for Research on Environment, Society and Health

Salutogenic and equigenic environments now and in the future: what do we know and what don't we know?

Prof Rich Mitchell

In my world, we think about health like this; thousands to millions of people. What makes it more or less likely that they get sick? We are increasingly concerned about environmental change.



Public health had great success in the past, by thinking about our environment and how it affects our health

The Rockefeller Foundation THE LANCET

Lancet 2015; 386: 1973–2028
Published Online July 16, 2015 http://dx.doi.org/10.1016/S0140-6736(15)60901-1

The Rockefeller Foundation–Lancet Commission on planetary health

Safeguarding human health in the Anthropocene epoch: report of The Rockefeller Foundation–Lancet Commission on planetary health

Sarah Whitmee, Andy Haines, Chris Beyrer, Frederick Boltz, Anthony G Capon, Braulio Ferreira de Souza Dias, Alex Ezeh, Howard Frumkin, Peng Gong, Peter Head, Richard Horton, Georgina M Mace, Robert Marten, Samuel S Myers, Sania Nishtar, Steven A Osofsky, Subhrendu K Pattanayak, Montira J Pongsiri, Cristina Romanelli, Agnes Soucat, Jeanette Vega, Derek Yach

This online publication has been corrected. The corrected version first appeared at thelancet.com on August 17, 2015

See Comment pages 1921, e36, e37, and e39

For infographic see http://www.thelancet.com/infographics/planetary-health

Executive summary

Far-reaching changes to the structure and function of the Earth's natural systems represent a growing threat to human health. And yet, global health has mainly improved as these changes have gathered pace. What is the explanation? As a Commission, we are deeply concerned that the explanation is straightforward and sobering: we have been mortgaging the health of future generations to realise economic and development gains in the present. By unsustainably exploiting nature's resources, human civilisation has flourished but now risks substantial health effects from the degradation of nature's life support systems in the future. Health effects from changes to the environment including climatic change, ocean acidification, land degradation, water scarcity, overexploitation of fisheries, and biodiversity loss pose serious challenges to the global health gains of the past several decades and are likely to become increasingly dominant during the second half of this century and beyond. These striking trends are driven by highly inequitable, inefficient, and unsustainable patterns of resource consumption and technological development, together with population growth.

We identify three categories of challenges that have to be addressed to maintain and enhance human health in the face of increasingly harmful environmental trends. Firstly, conceptual and empathy failures (imagination challenges), such as an over-reliance on gross domestic product as a measure of human progress, the failure to account for future health and environmental harms over present day gains, and the disproportionate effect of those harms on the poor and those in developing nations. Secondly, knowledge failures (research and information challenges), such as failure to address social and environmental drivers of ill health, a historical scarcity of transdisciplinary research and funding, together with an unwillingness or inability to deal with uncertainty within decision making frameworks. Thirdly, implementation failures (governance challenges), such as how governments and institutions delay recognition and responses to threats, especially when faced with uncertainties, pooled common resources, and time lags between action and effect.

Although better evidence is needed to underpin appropriate policies than is available at present, this should not be used as an excuse for inaction. Substantial potential exists to link action to reduce environmental damage with improved health outcomes for nations at all levels of economic development. This Commission identifies opportunities for action by six key constituencies: health professionals, research funders and the academic community, the UN and Bretton Woods bodies, governments, investors and corporate reporting bodies, and civil society organisations.

Depreciation of natural capital and nature's subsidy should be accounted for so that economy and nature are not falsely separated. Policies should balance social progress, environmental sustainability, and the economy. To support a world population of 9–10 billion people or more, resilient food and agricultural systems are needed to address both undernutrition and overnutrition, reduce waste, diversify diets, and minimise environmental damage. Meeting the need for modern family planning can improve health in the short term—eg, from reduced maternal mortality and reduced pressures on the environment and on infrastructure.

Planetary health offers an unprecedented opportunity for advocacy of global and national reforms of taxes and subsidies for many sectors of the economy, including energy, agriculture, water, fisheries, and health. Regional trade treaties should act to further incorporate the

For A Haines FMedSci, R Marten MPH): Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, USA (Prof C Beyrer MD); The Rockefeller Foundation, New York, NY, USA (F Boltz PhD, R Marten); International Institute for Global Health, United Nations University, Federal Territory of Kuala Lumpur, Malaysia (Prof A G Capon PhD); Convention on Biological Diversity, Montreal, QC, Canada (B F de Souza Dias PhD, C Romanelli MSc); African Population and Health Research Center, Nairobi, Kenya (A Ezeh PhD); School of

And a lot of thinking about health and environment remains rooted in the deficit model…

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Rather than ask ‘what makes us sick’, isn’t it better to ask ‘what keeps us well?’ Can our environment play a role?


Can we find ‘salutogenic’ environments: those which protect or improve health? Are these environments sustainable?
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Physical activity
Social contact
Restoration
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The evidence for a restorative effect comes primarily from experiments.

Experimental evidence: field

Park B, Tsunetsugu Y, Kasetani T, Kagawa T, Miyazaki Y. The physiological effects of Shinrin-yoku (taking in the forest atmosphere or forest bathing): evidence from field experiments in 24 forests across Japan. Environmental Health and Preventive Medicine 2010; 15(1):18-26.

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Adrenaline concentration

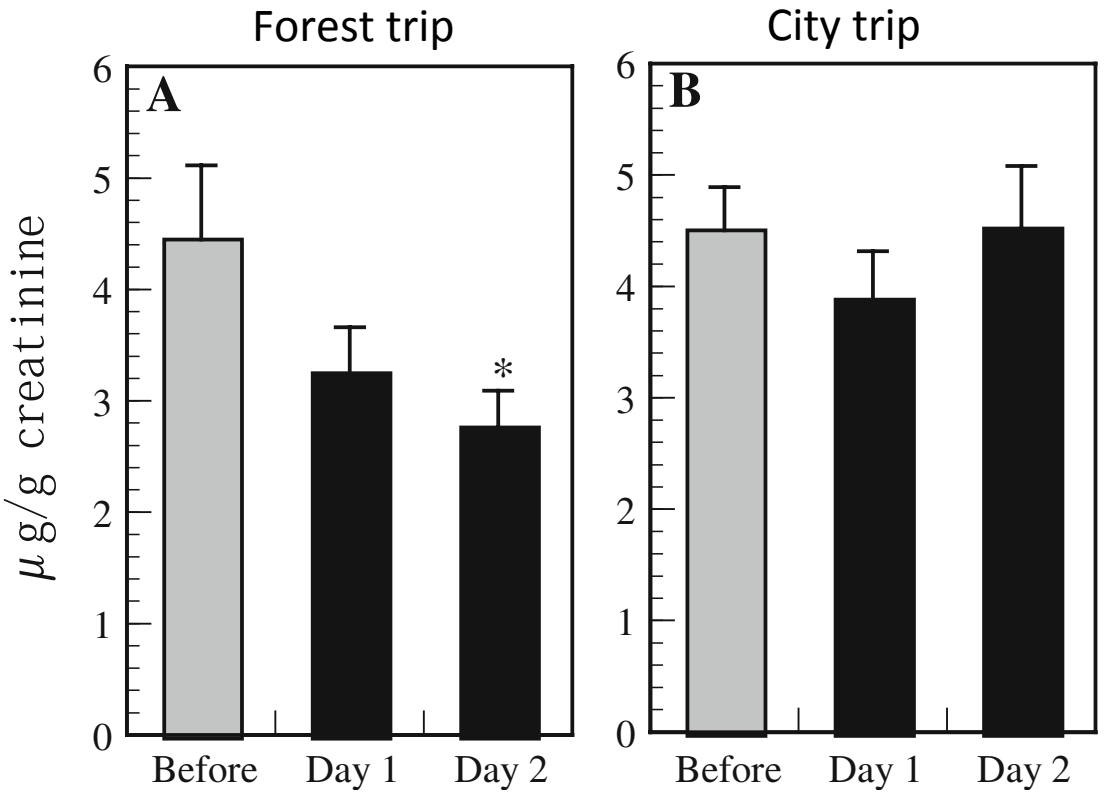

Fig. 9 Effect of a forest bathing trip on adrenaline and noradrenaline concentrations in urine. a Effect of a forest bathing trip on urinary adrenaline concentration in male subjects (n = 12), b effect of a city trip on urinary adrenaline concentration in male subjects (n = 11)

Li, Qing. "Effect of forest bathing trips on human immune function." Environmental health and preventive medicine 15, no. 1 (2010): 9-17.

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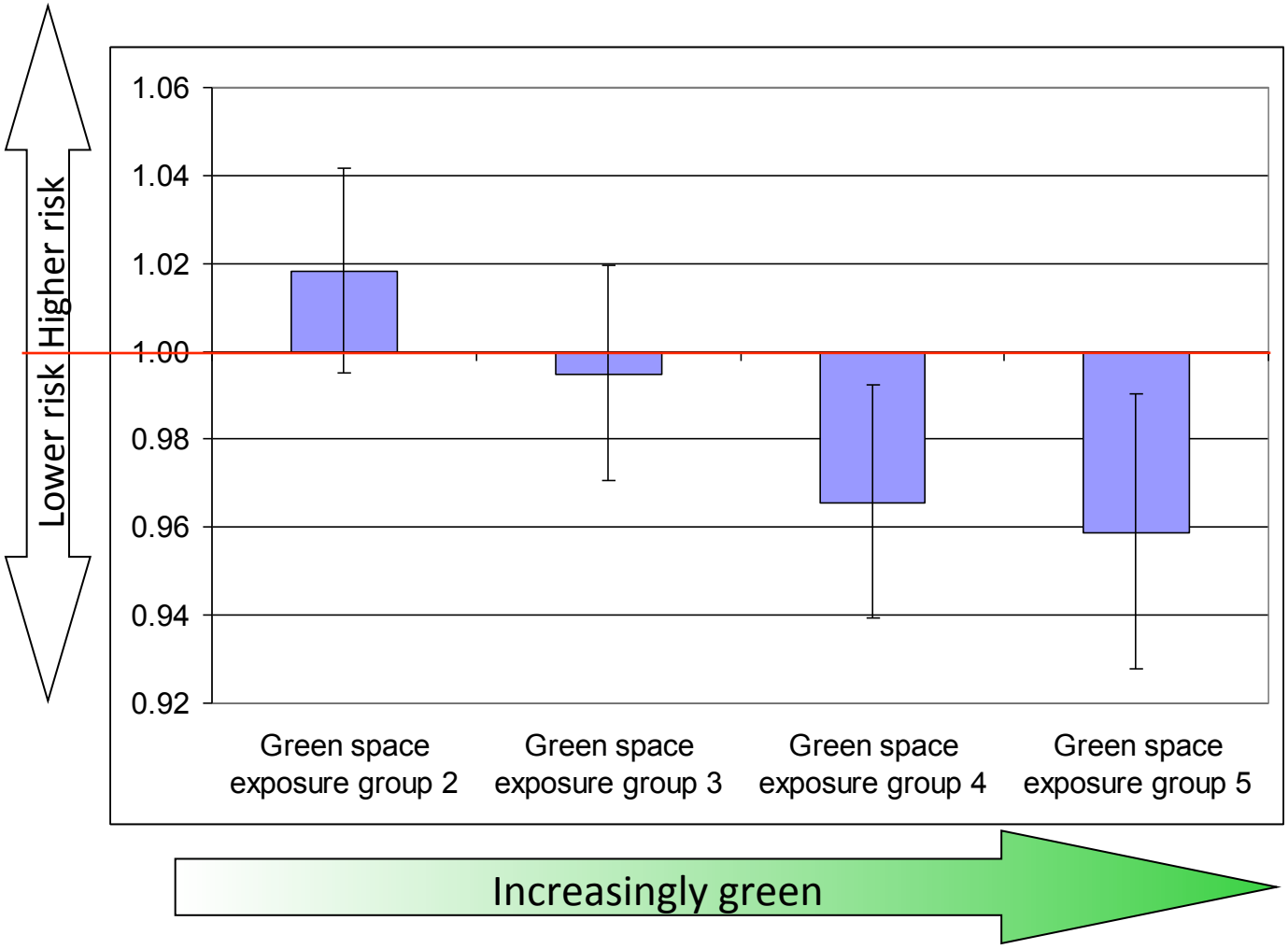
Deaths from heart disease



Mitchell R, Popham F. Effect of exposure to natural environment on health inequalities: an observational population study. The Lancet 372(9650):1655-1660.

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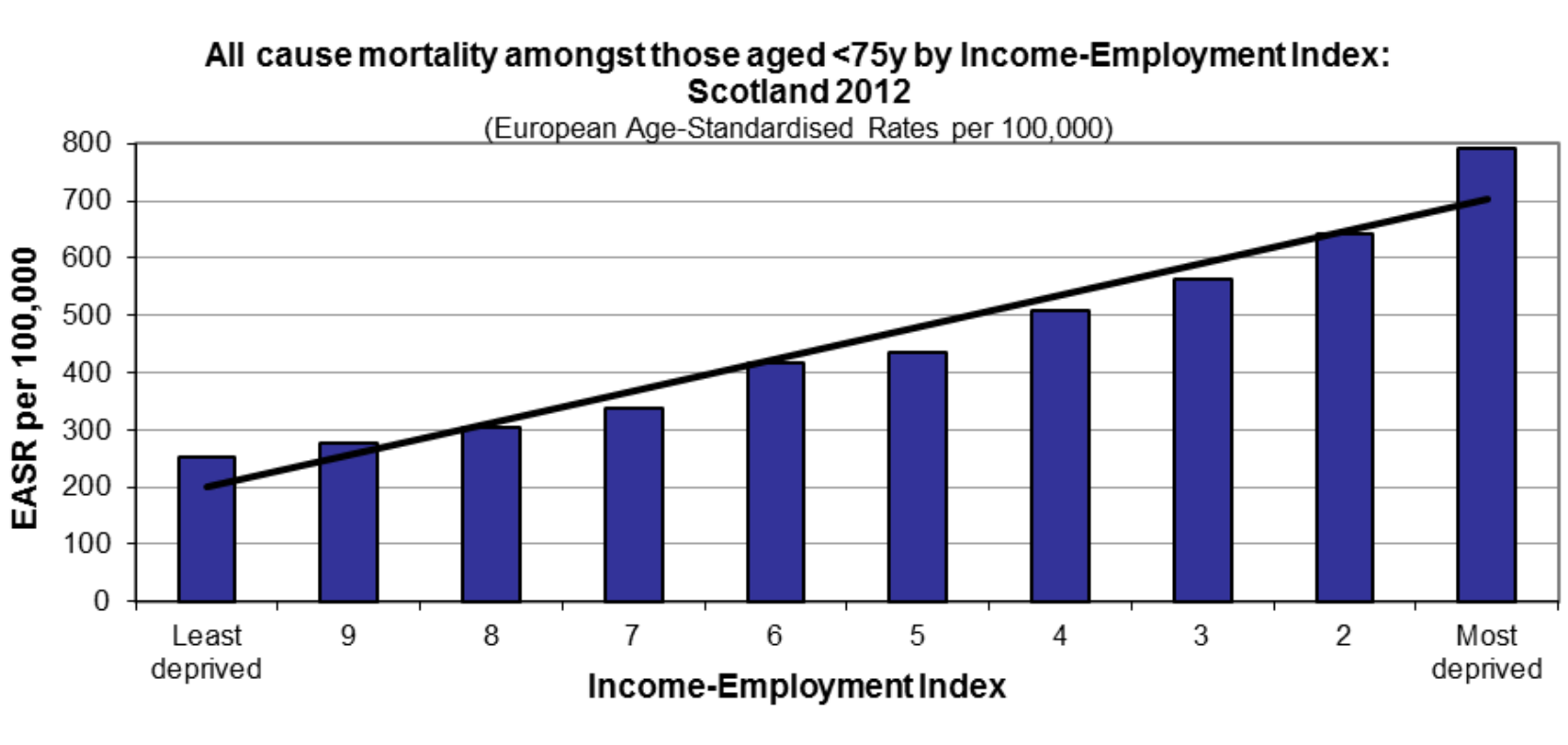
Let's think about inequalities in health for a moment.



Scottish Government. Long-term Monitoring of Health Inequalities: Headline Indicators 2014

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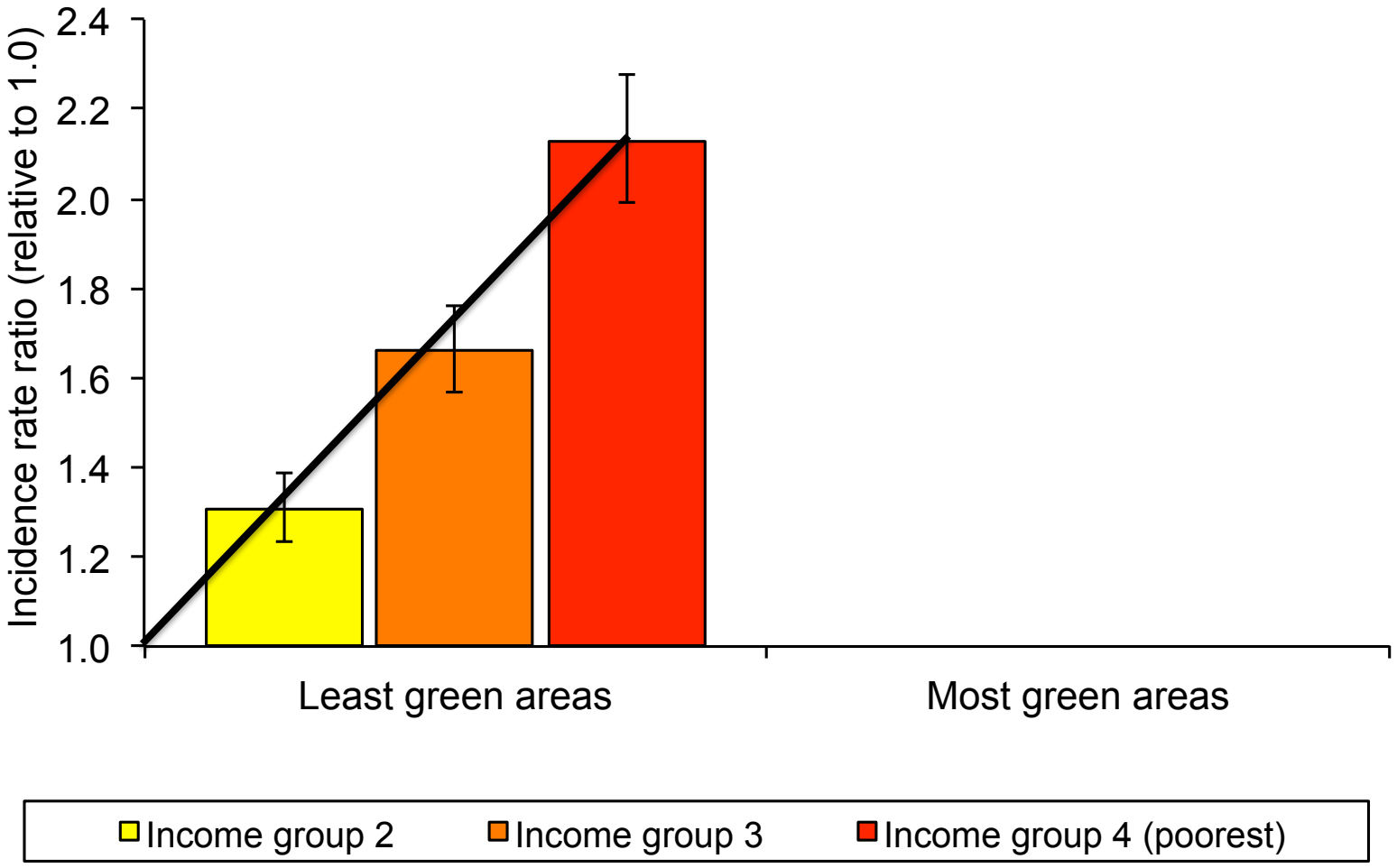
We hypothesise that some places are *equigenic*; features of their social, physical or service environments act to create health equality. We are interested in finding, defining and using the notion of *equigenesis*

http://cresh.org.uk/2013/11/08/what-is-equigenesis-and-how-might-it-help-narrow-health-inequalities/

Income-related health inequality may be smaller in greener neighbourhoods.



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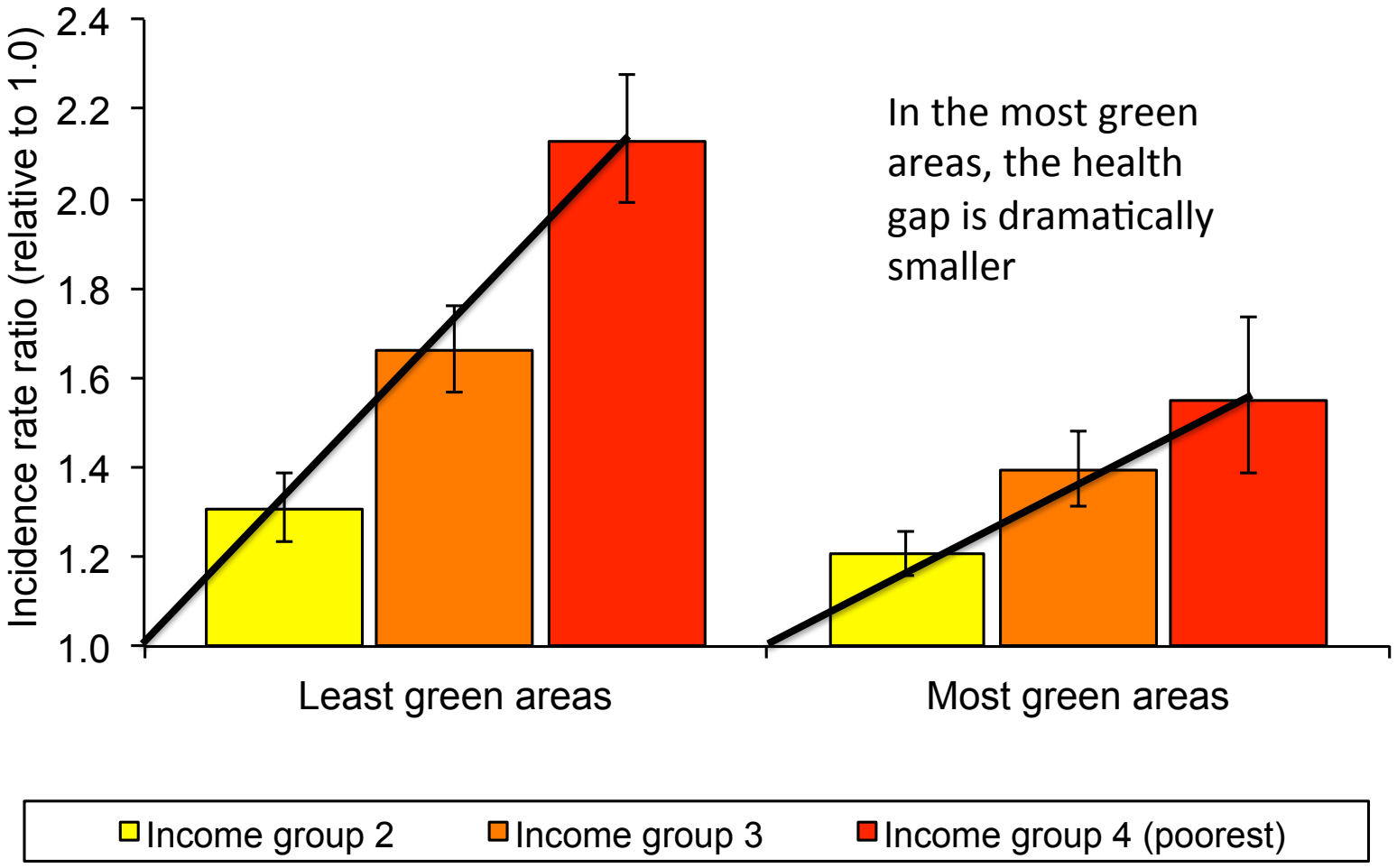

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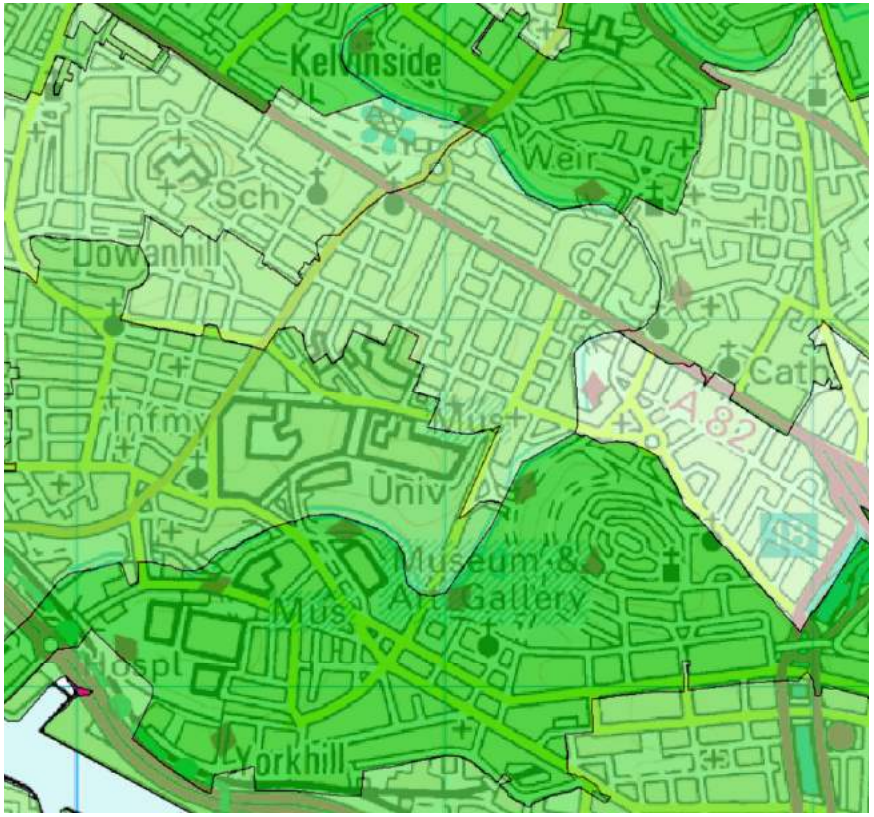
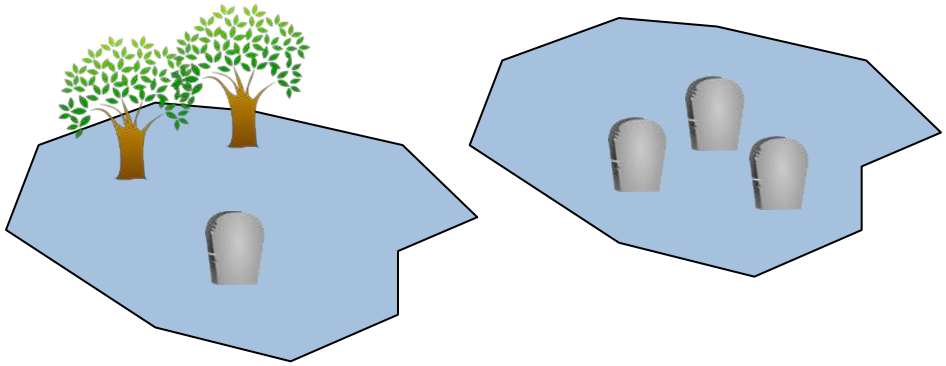
How do we do this work?



Estimates of the % land area in a neighbourhood that is green space
www.cresh.org.uk



(1) Relate the health of everyone in a neighbourhood to how much green space there is (comparing neighbourhoods)

Mortality data from GROS & ONS (2001-2005)

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Measuring exposure

Glasgow: Kelvinbridge and Botanical Gardens

Google Map *Ordnance Survey MasterMap (OSMM)*

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Measuring exposure

Glasgow: Kelvinbridge and Botanical Gardens

Google Map

EEA CORINE

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We worry about analyses like these.
What kinds of people tend to have better access to green space, what other features of neighbourhoods with good / poor access to green spaces might influence results?
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European Quality of Life Survey - 34 countries, asking questions about social, economic and environmental aspects of life. Also includes a well-validated measure of mental health and wellbeing, the WHO-5 (0-100, where 100 is best health)

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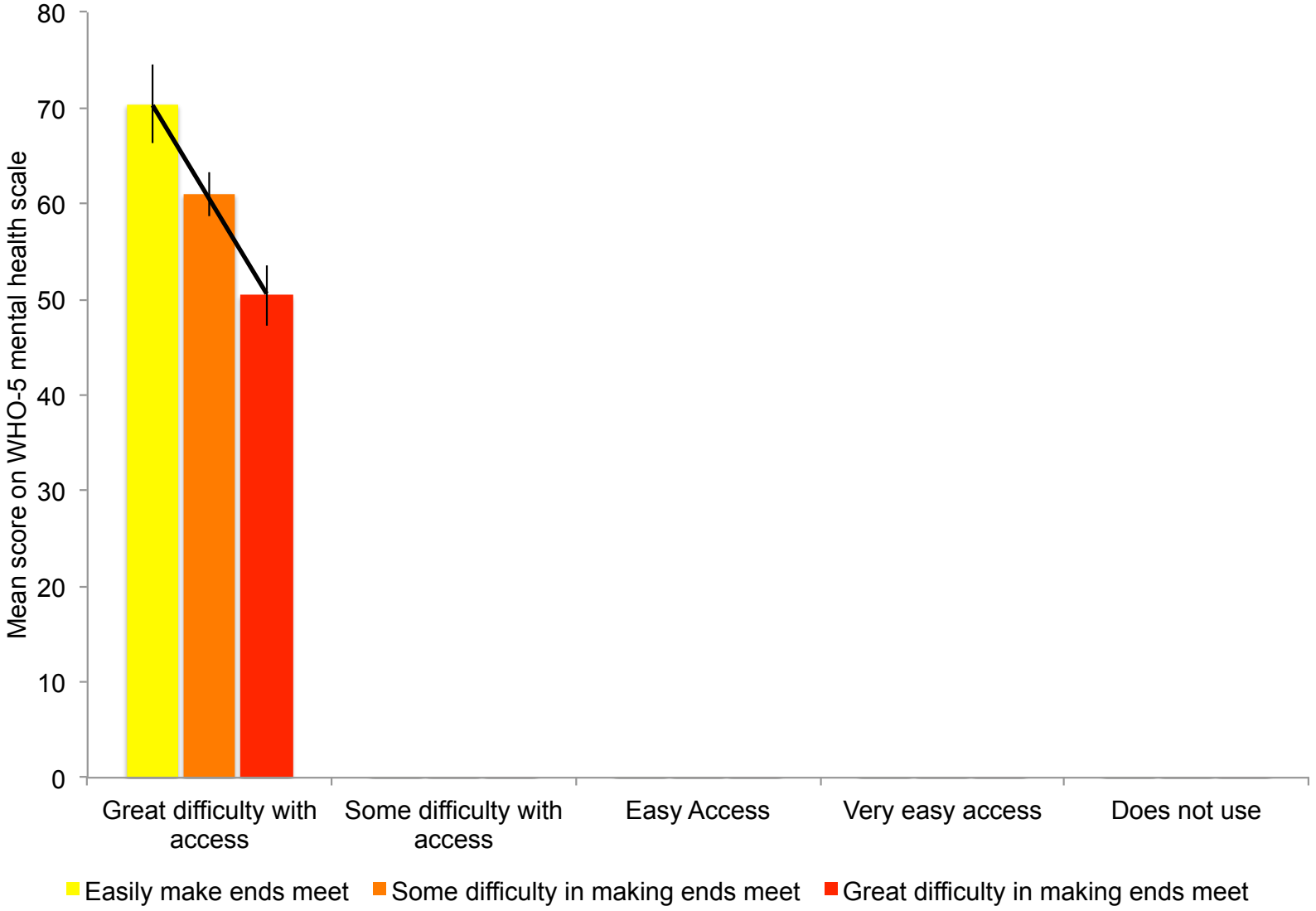
There are large income-inequalities in mental health



Mitchell et al. Neighborhood Environments and Socioeconomic Inequalities in Mental Well-Being *American journal of preventive medicine* (2015).

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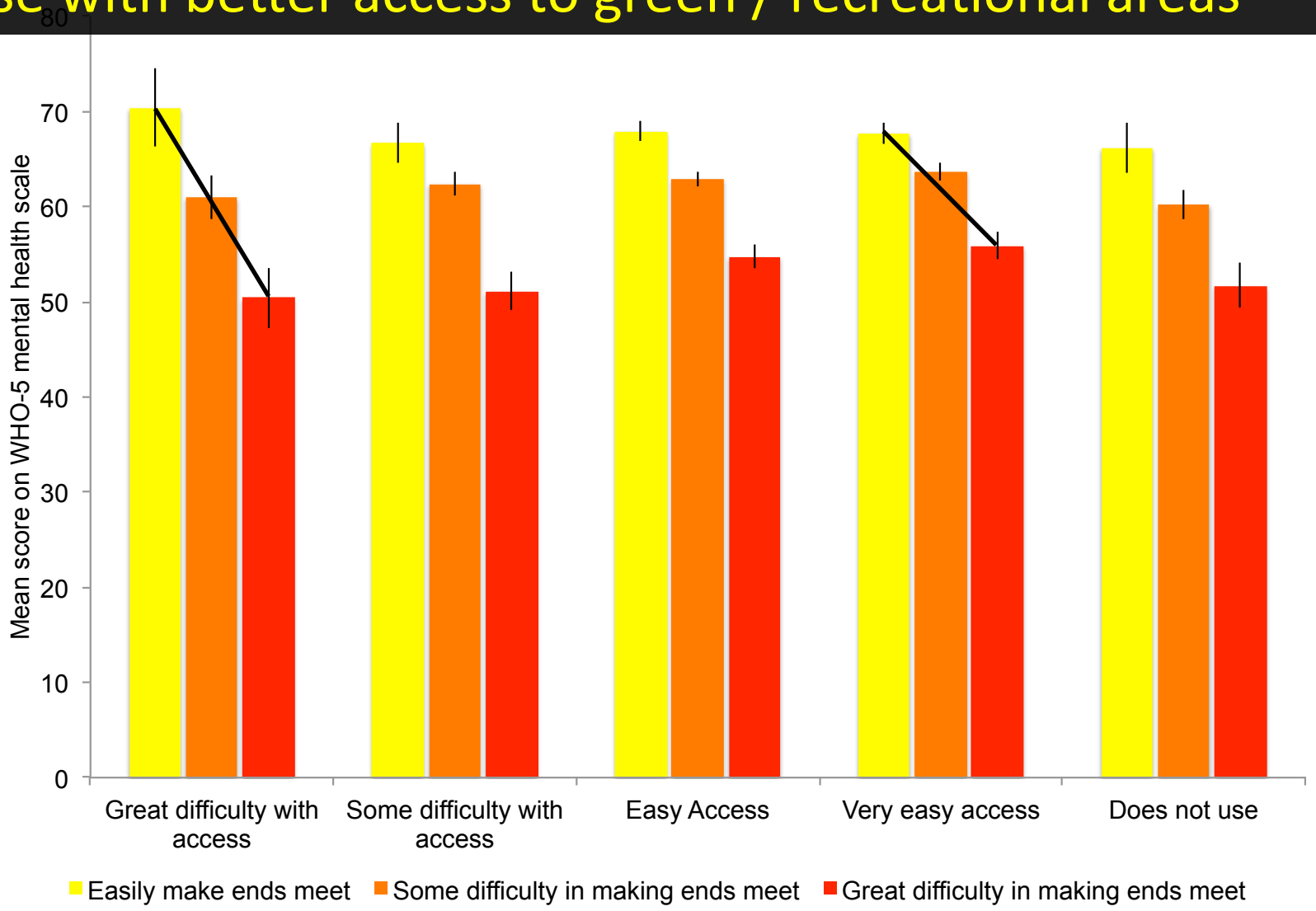
Income-related mental health inequality was smaller among those with better access to green / recreational areas



Mitchell et al. Neighborhood Environments and Socioeconomic Inequalities in Mental Well-Being *American journal of preventive medicine* (2015).

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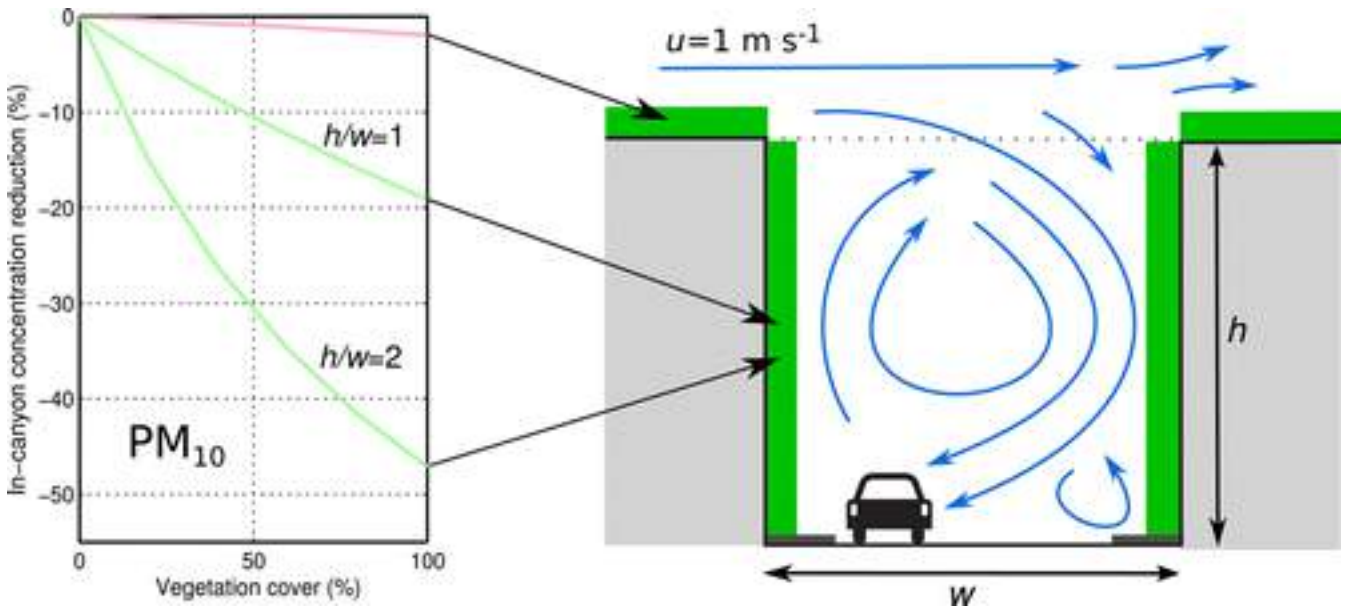

Increasing deposition by the planting of vegetation in street canyons can reduce street-level concentrations in those canyons by as much as 40% for NO2 and 60% for PM. Pugh et al Environ. Sci. Technol. 2012, 46, 7692−7699

"Grass reduced maximum surface temperatures by up to 24°C, similar to model predictions, while tree shade reduced them by up to 19°C. In contrast, surface composition had little effect upon globe temperatures, whereas shading reduced them by up to 5–7°C"

Armson, D., P. Stringer, and A. R. Ennos. "The effect of tree shade and grass on surface and globe temperatures in an urban area." Urban Forestry & Urban Greening 11.3 (2012): 245-255.

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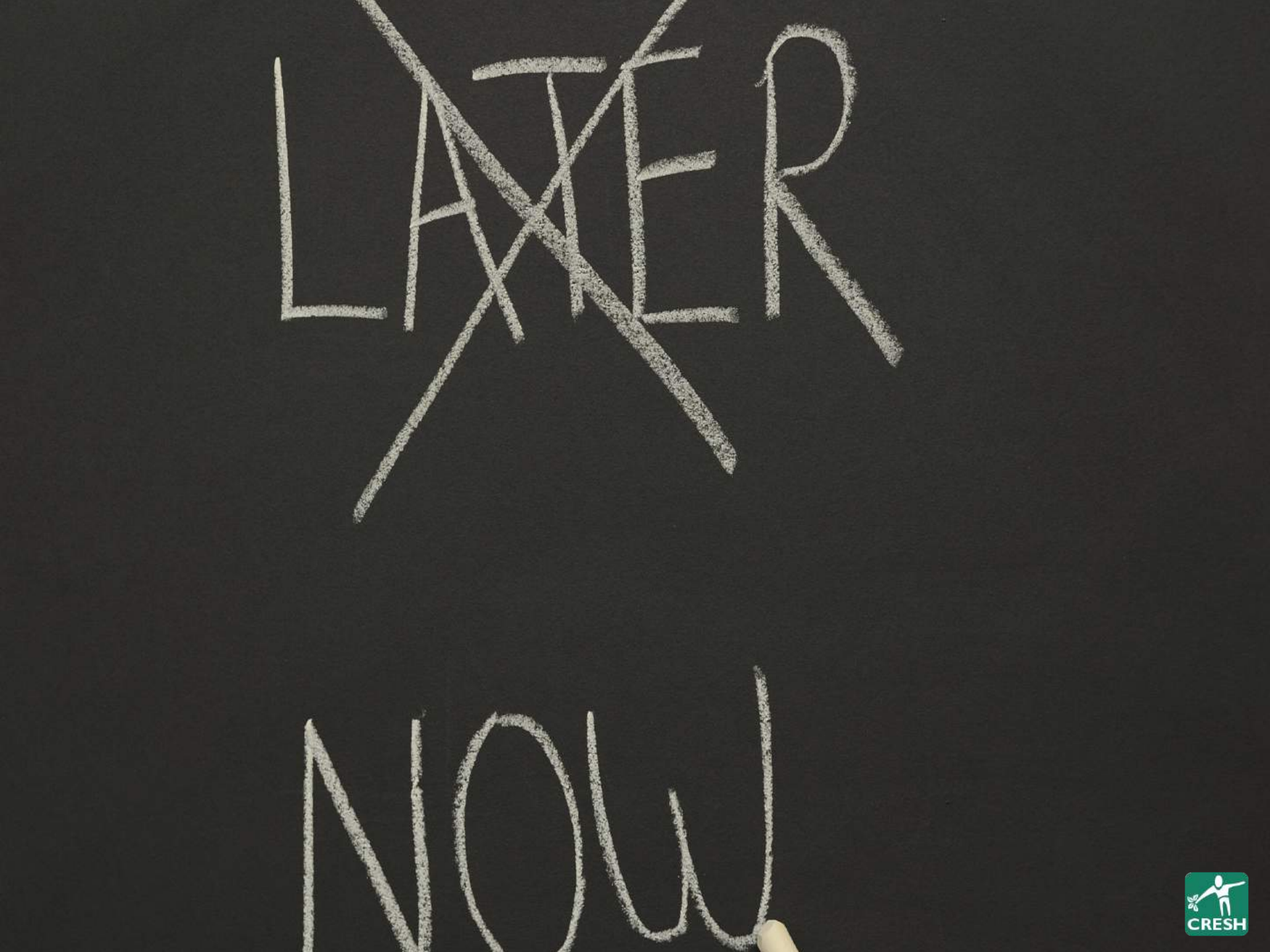
LATER
NOW

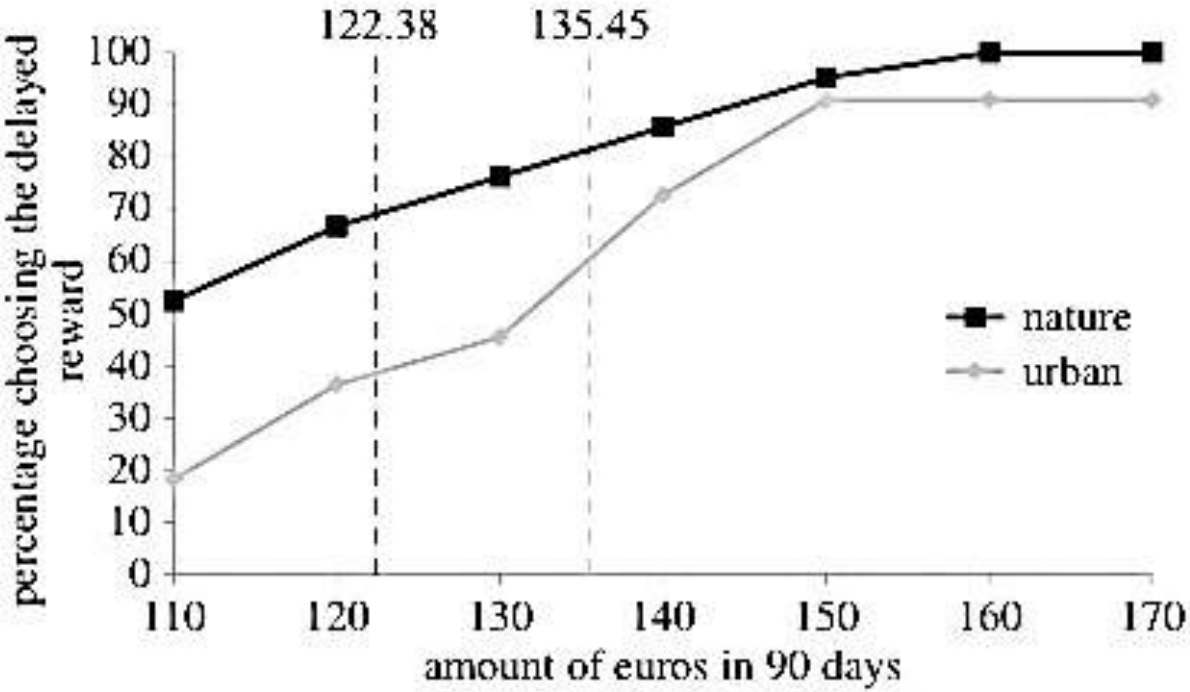

Figure 3. Percentage of participants that preferred the '*x*' amount of euros in 90 days over the 100 euros now (Experiment 3), including the average individual indifference point for each condition. Nature condition differs significantly from the urban condition ($p < 0.05$).

van der Wal, Arianne J., et al. "Do natural landscapes reduce future discounting in humans?." *Proceedings of the Royal Society B: Biological Sciences* 280.1773 (2013): 20132295.

Time is vital. Relationships between environment, environmental behaviours, and health evolve and interact over life-times.

Historical archives. Example of reconstructed green space data for Edinburgh. Attach them to cohort data

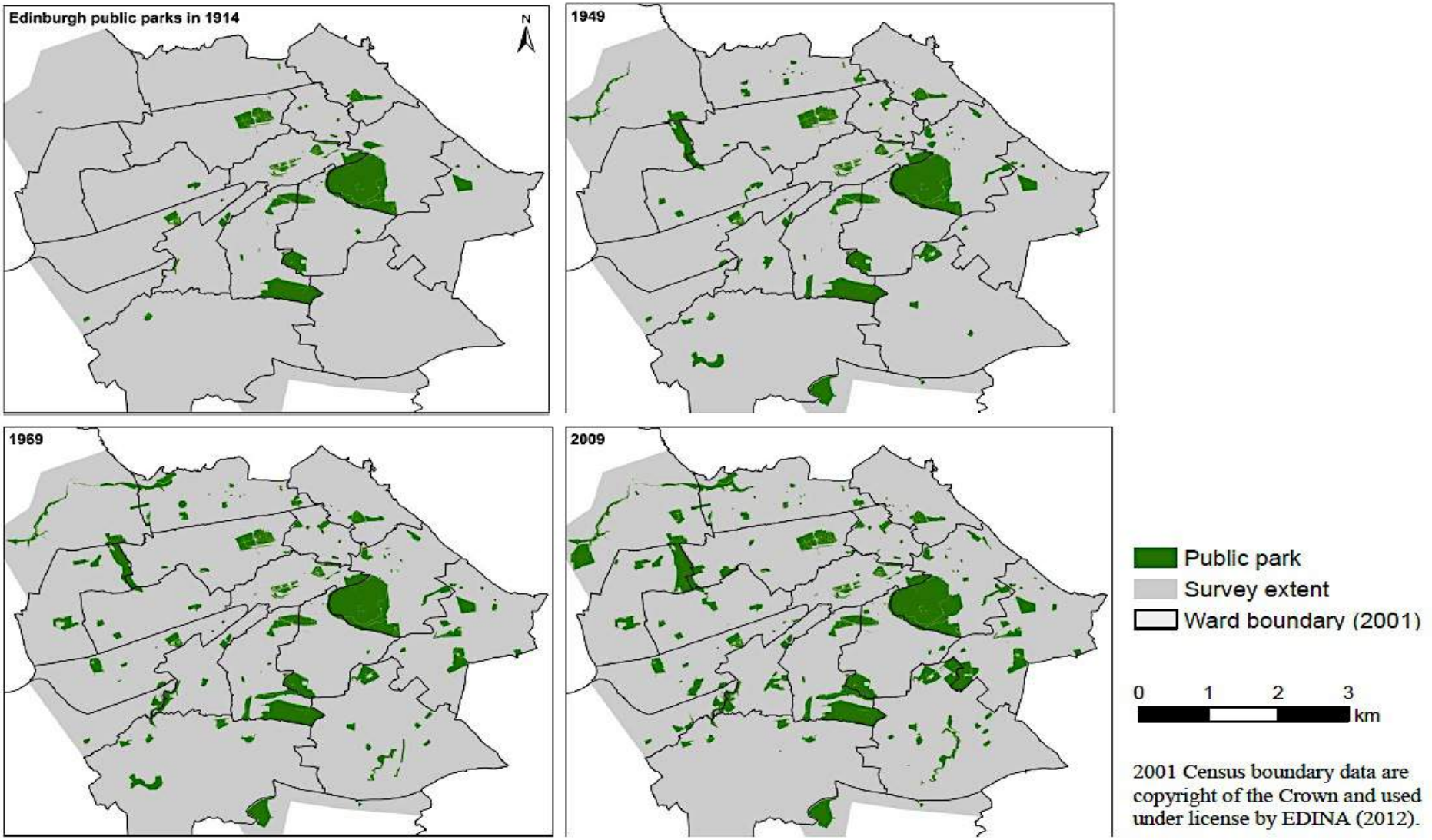

Figure 2. Mapping the public parks in Edinburgh in 1914, 1949, 1969 and 2009.
Data sources: M'Hattie 1914, Abercrombie et al. 1949, City of Edinburgh Council (Town Planning Department) 1965, 1969 & 2009

Work led by Jamie Pearce, Funded by the European Research Council [ERC- 2010-StG Grant 263501].

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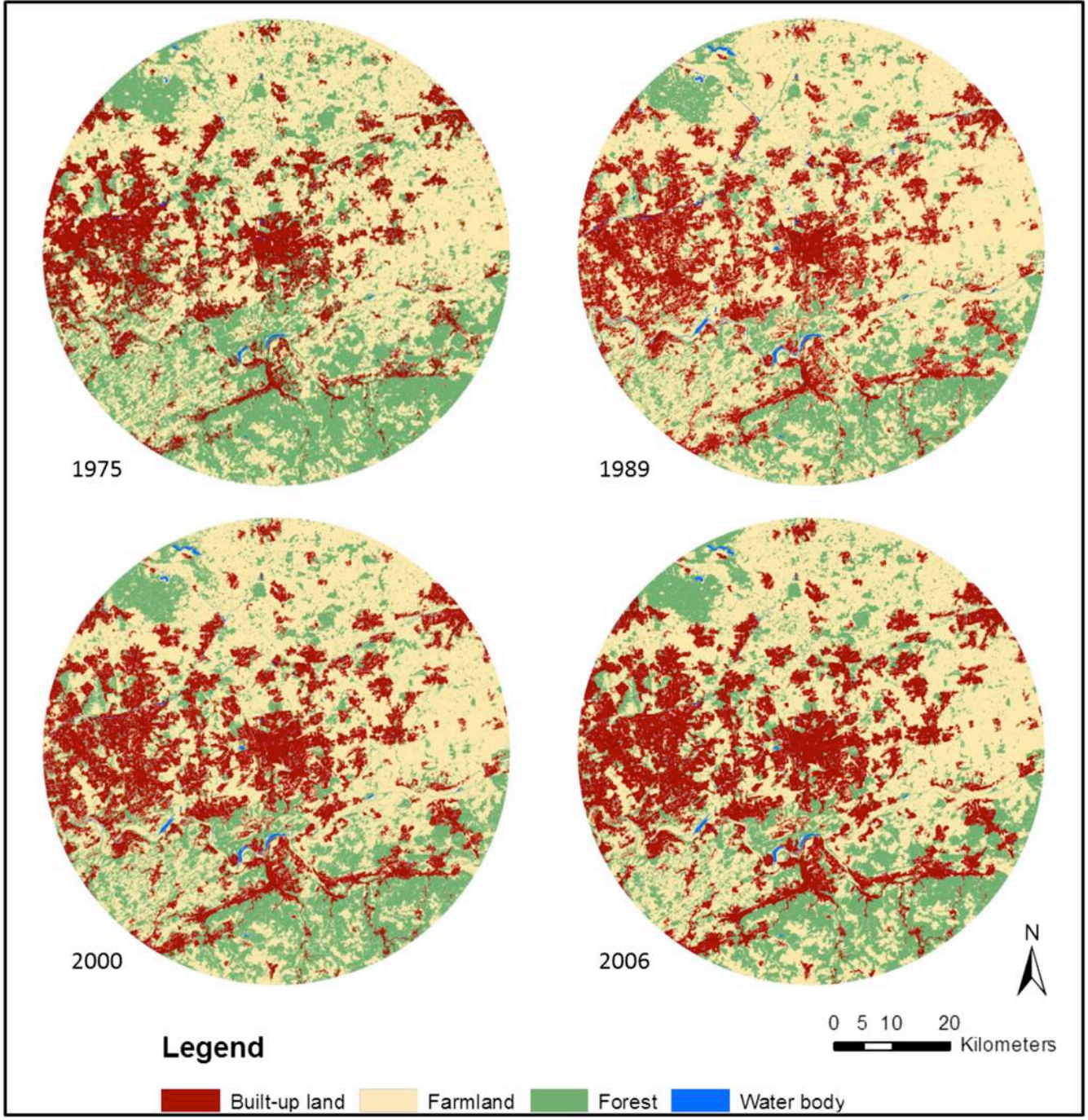
Only one way to get contiguous, consistent, repeated measures of environment, applicable internationally, over time (1970s ->).



Li & Thinh. Appl. Remote Sens. 7(1), 073458 (Dec 23, 2013). doi:10.1117/1.JRS.7.073458

But, environment data don't always easily reveal human interactions

It’s not just the environment. We need to know where people are, and what they’re doing… back in / over time. What if our existing surveys / cohorts didn’t ask the right questions?

‘Life grid’ technique – local, global and personal events are used to prompt recollection of past home addresses, behaviours, lifestyles

Year	Home address	Local/global/personal events	Work
	Write the street name, suburb and town/city of the home where you lived at the start of each decade e.g. 1930, 1940, 1950…	Major events that may help you date home address. Personal events could include the likes of marriage, birth of children, major holidays, death of parents…	**Write the title of your job** (or your Father’s job if appropriate) at the start of each decade
1970 1972 1974 1976 1978	Eglen Rea Cottages Gorgie Road Edinb.	Oil crisis Married Margaret Thatcher becomes prime minister	Self Employed Mobile Fruit Van
1980 1982 1984 1986 1988	Harrison Gardens Slateford Edinb.	Falklands War Father Died Lockerbie bombing, Hillsborough disaster	
1990 1992 1994 1996 1998	Forrester Park Gardens Edinb. EH12	John Major becomes prime minister Diana Princess of Wales dies Scottish Parliament opened	Self Employed Black Taxi Driver
2000 2002 2004 2006 2008		9/11 attacks in New York	
2010 2012 2014		Earthquake and tsunami off coastal Japan	

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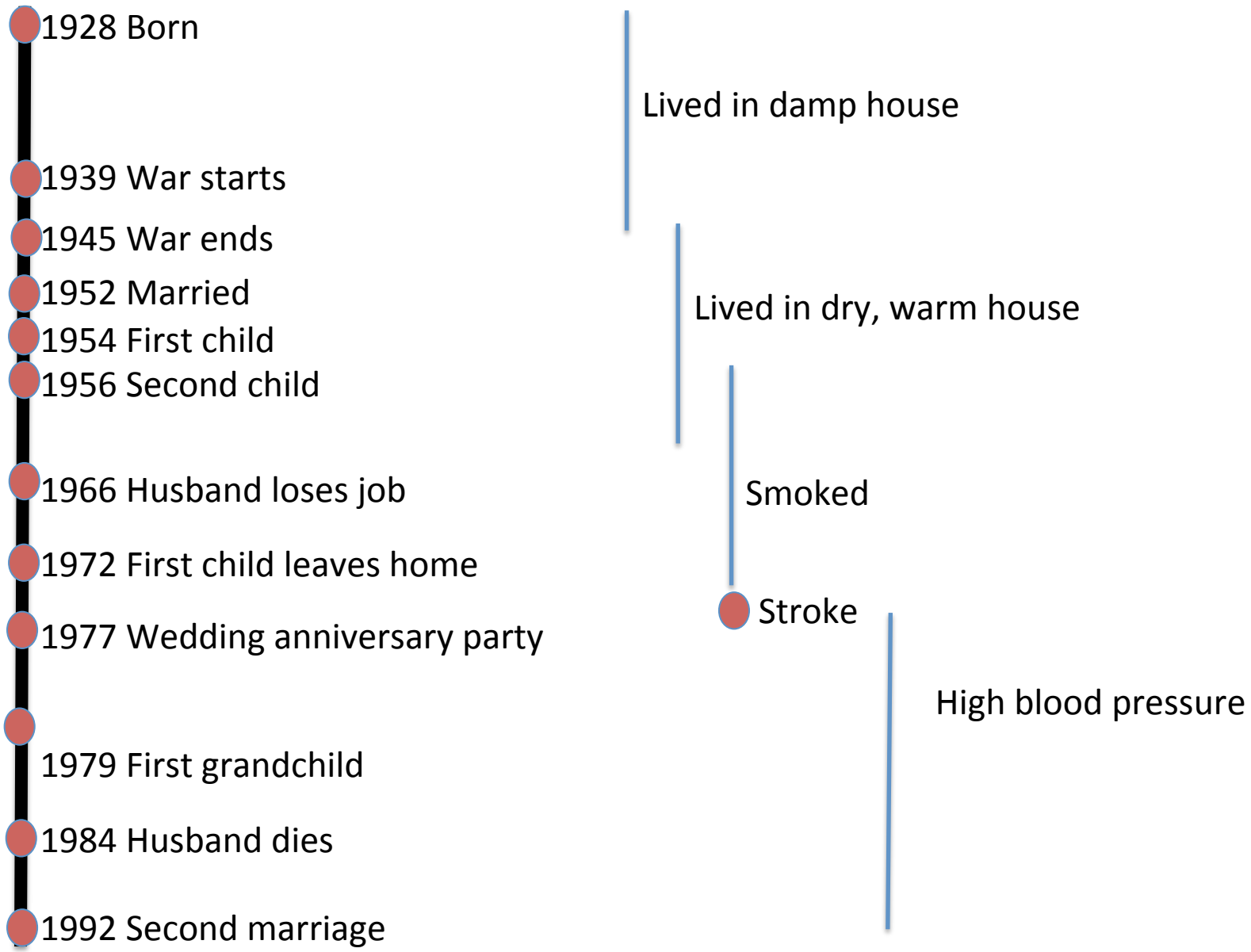
1928 Born
1939 War starts
1945 War ends
1952 Married
1954 First child
1956 Second child
1966 Husband loses job
1972 First child leaves home
1977 Wedding anniversary party
1979 First grandchild
1984 Husband dies
1992 Second marriage
Lived in damp house
Lived in dry, warm house
Smoked
Stroke
High blood pressure


Potential data: we have access to rich data about our current and recent environments, and these can be sources of data on behaviour too
Kelvindale, opp...
Kelvindale, after...
Weymouth Dr
Cleveden Rd
© 2012 Google
Report a problem
Image Date: October 2008
CRESH

Figure 1. Images of cycle traffic before (left; 2009) and after (right; 2010) construction of a cycling path Note: Photos show the intersection of Pennsylvania Avenue NW and 9th Street NW, Washington DC;

Images processed by Mechanical Turk

Hipp et al. Emerging Technologies: Webcams and Crowd-Sourcing to Identify Active Transportation. American Journal of Preventive Medicine, Volume 44, Issue 1, 2013, 96–97

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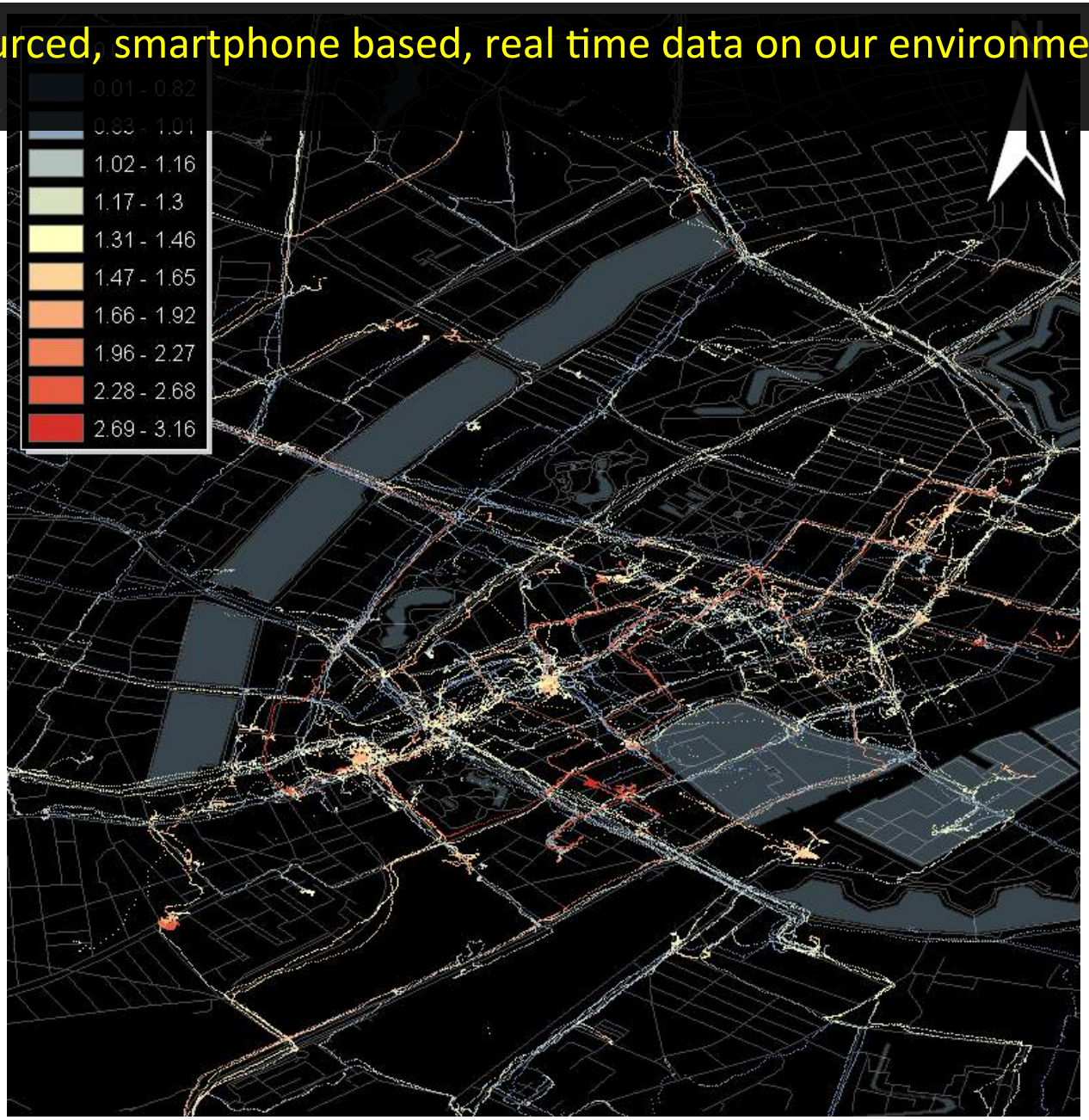
Kelvin Way
Glasgow, Scotland
Street View - Aug 2015
Kelvin Way
Kelvingrove Lawn Bowls Centre
Back to Map
Google
Image capture: Aug 2015
© 2015 Google
Terms
Privacy

Crowd-sourced, smartphone based, real time data on our environments: the smart city.



Mobile CO measurements in the city of Copenhagen (December 2009).
Kamel Boulos et al. International Journal of Health Geographics 2011, 10:67

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WHO OWNS A SMARTPHONE

% OWN A SMARTPHONE BY GENDER AND SOCIAL GRADE

	All	15-24	25-34	35-44	45-54	55-64	65+
Males	68%	91%	90%	85%	72%	57%	22%
Males AB	75%	98%	100%	98%	89%	70%	30%
Males C1	73%	94%	95%	86%	68%	65%	21%
Males C2	64%	87%	86%	73%	77%	44%	16%
Males DE	59%	86%	84%	74%	47%	32%	14%
Females	65%	90%	91%	86%	73%	48%	18%
Females AB	71%	93%	95%	93%	83%	62%	27%
Females C1	69%	95%	96%	88%	81%	51%	21%
Females C2	63%	82%	92%	86%	65%	40%	9%
Females DE	55%	88%	83%	74%	47%	32%	11%

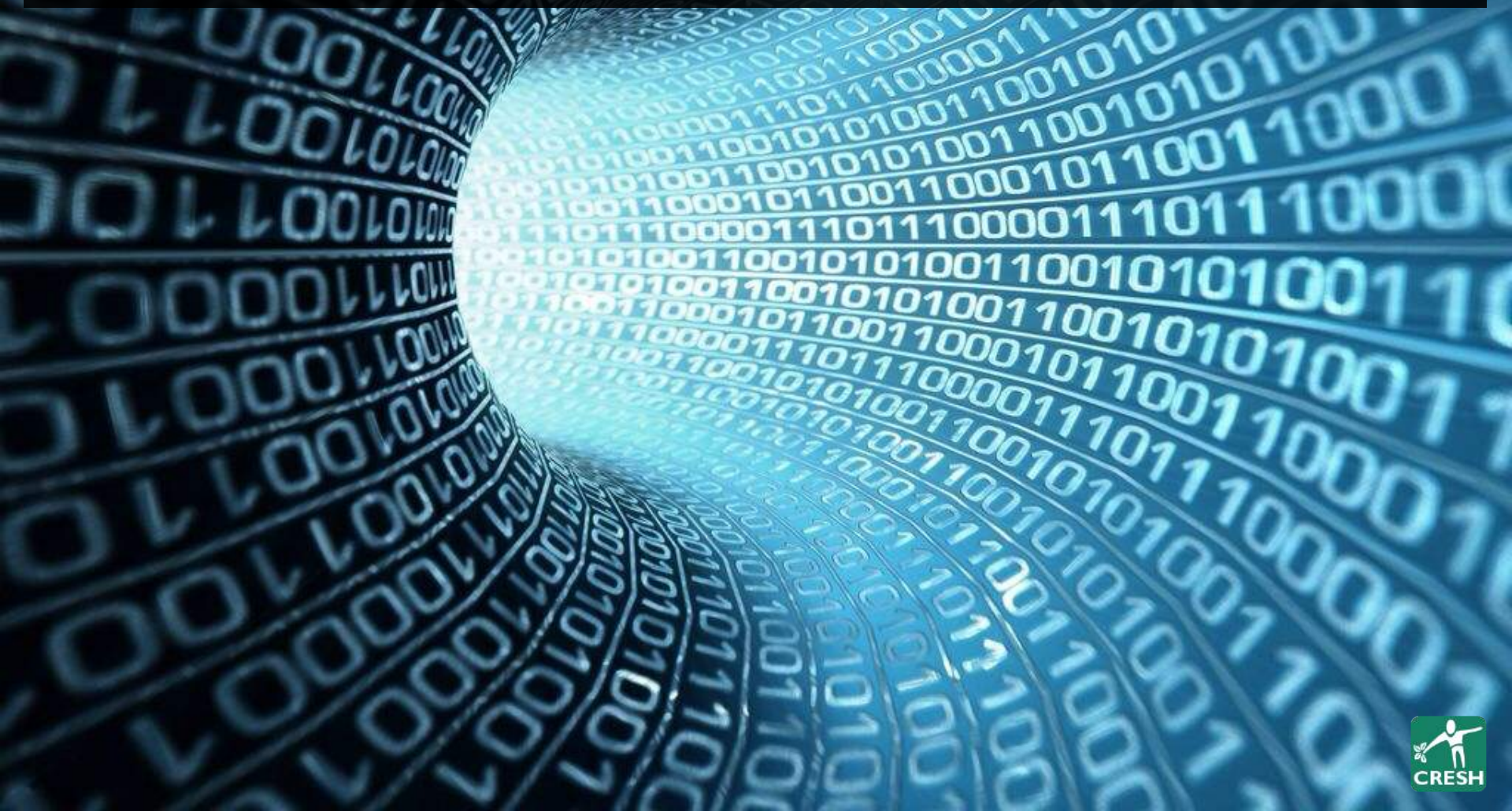
0-49% 50-69% 70-100%

Base: circa 4,000 GB adults aged 15+: Q3/ Q4 2014 Q1/Q2 2015

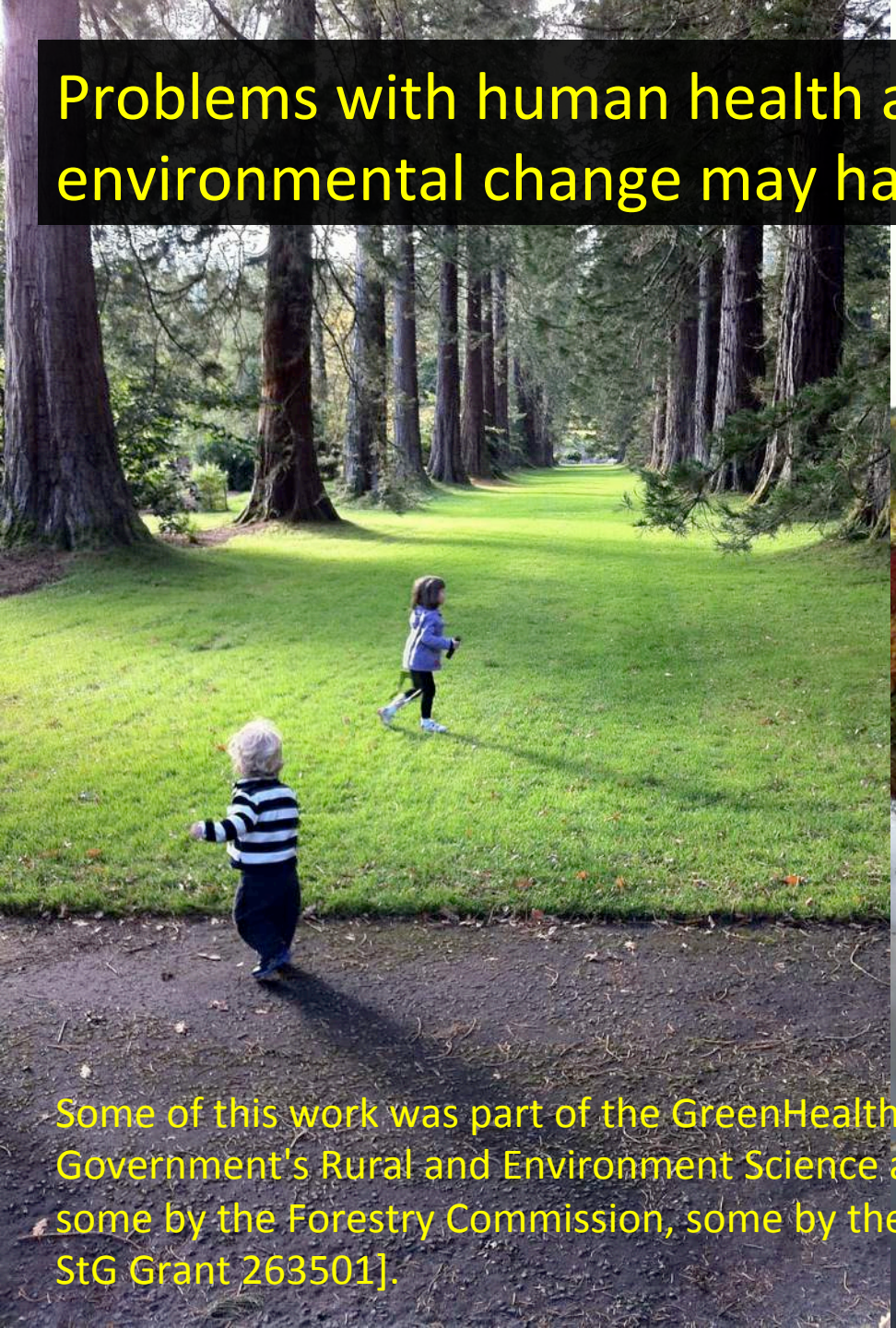
Source: Ipsos MORI

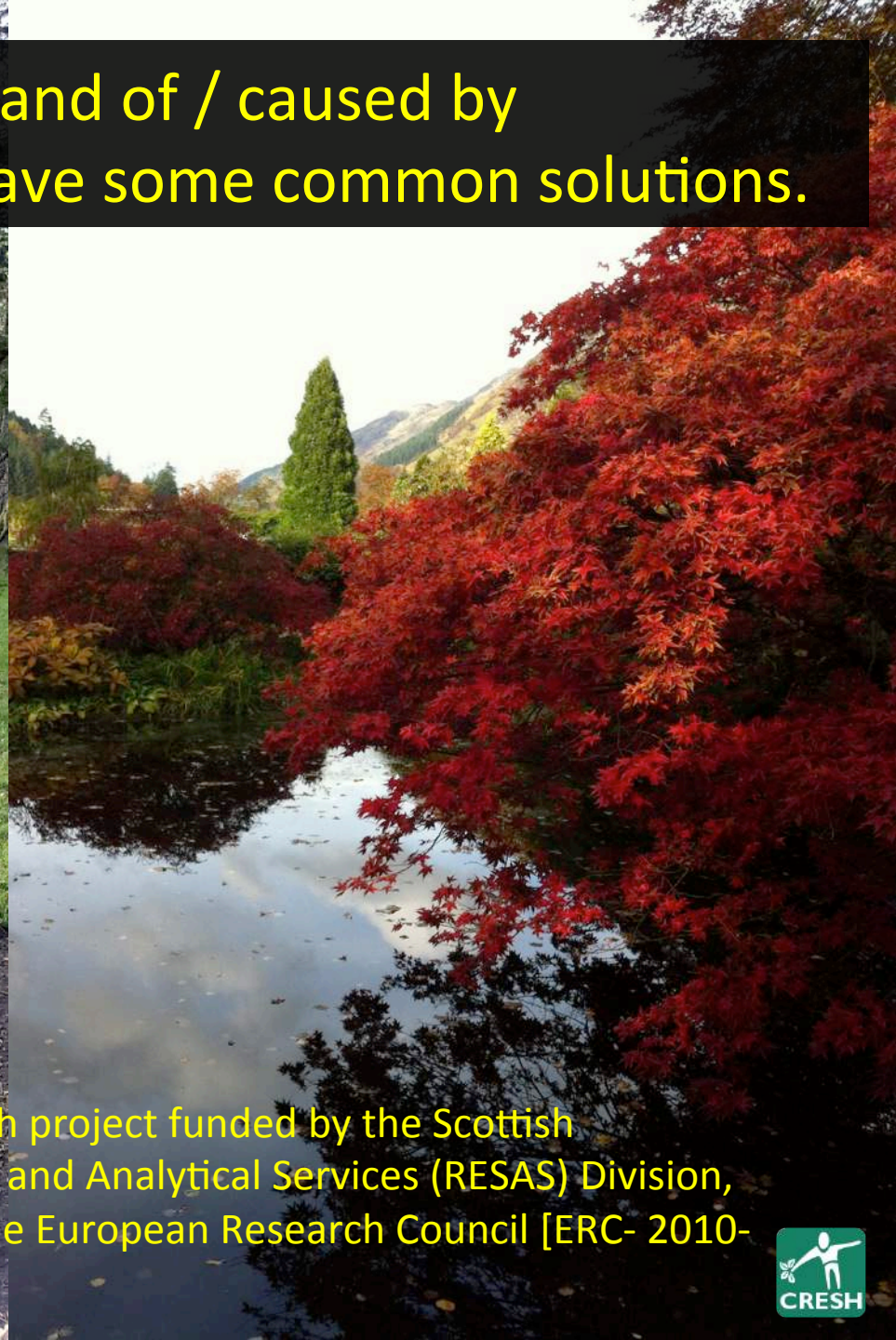
I think our biggest challenge is to find or create data which permit an understanding of people, their health, their environment, how these *interact*, and how these relationships are affected by change. That means consistent data, over time.

I am excited about the potential for equigenesis, but to investigate we need data from across the social and demographic spectrum. Some kinds of 'bigger' data provide this, but others may well not.



Problems with human health and of / caused by environmental change may have some common solutions.





Some of this work was part of the GreenHealth project funded by the Scottish Government's Rural and Environment Science and Analytical Services (RESAS) Division, some by the Forestry Commission, some by the European Research Council [ERC- 2010-StG Grant 263501].

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