

# HEALTH AND PLACE

## SOCIAL AND ECONOMIC VALUE OF COGNITIVE HEALTH IN A PLACE

BRIEFING REPORT, END-OF-GRANT (MAY 2023)

### WHAT DID WE PLAN TO DO?

- 1) Develop two methods that may contribute to the evaluation of the social and economic value of health in a place
  - a) Cognitive Footprint
  - b) GeoSPM
- 2) Apply these methods to cognitive health
- 3) Share any results related to “places” with public and policy makers in those “places”

### WHY EXPLORE COGNITION?

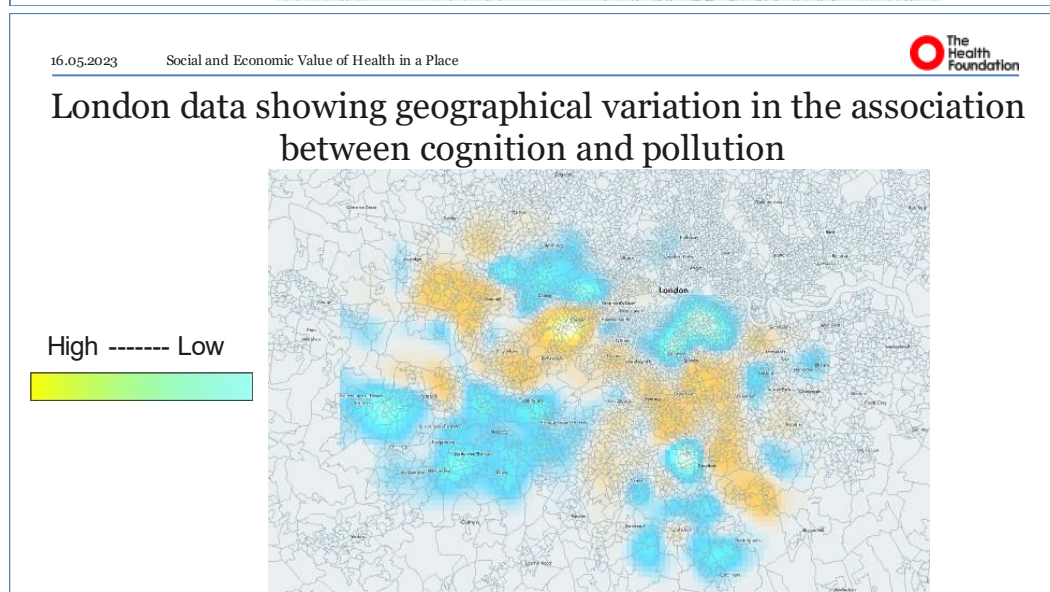
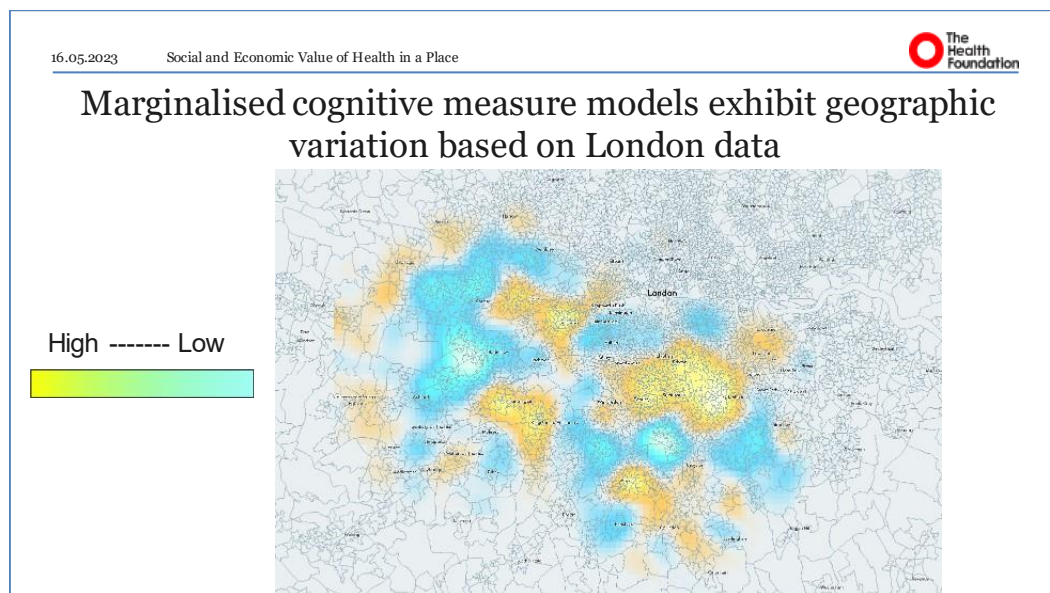
Cognition is a major driver of economic value and realisation of an individual’s cognitive potential is an ethical imperative. Cognition is sensitive to many negative and positive influences. These effects can be long-lasting, such as the protective effect of early life education on late life dementia, or short-term, such as the negative effect on cognition after ingestion of alcohol and poor sleep the night before. The Cognitive Footprint captures these effects by modelling both the effect size and duration.

### WHAT DID WE DO?

- 1) We explored the potential of a Cognitive Footprint metric by examining the effect of medication on cognition. Although not directly related to health in a place, it was a useful exemplar as side-effects are frequent and data on medication use and cognitive measures are available from UK Biobank and other cohorts.
- 2) We developed and validated a powerful new method for exploring cognition within geographical space. This built on a novel idea to apply the widely accepted statistical approach to brain mapping (statistical parametric mapping) to geography using an individual’s residential location as the unit of space, as opposed to the anatomical locations that are used in brain imaging analyses. The new method, GeoSPM, facilitates unbiased identification of geographies of significant cognitive variation and of significant associations with other variables, yielding interpretable statistical maps founded on secure statistical principles. We then shared the data with public and policy makers in the area of study.

## WHAT DID WE FIND?

- 1) Medication use has both positive and negative associations with cognitive measures. The reaction time, a measure of attention, was the most sensitive measure and is likely to be useful for measuring the short-term fluctuations that the Cognitive Footprint captures.
- 2) Our application of GeoSPM to the effects of pollution on cognition in UK Biobank has revealed subregions within sampled areas where pollution may induce cognitive effects unexplained by other factors. This work, currently in preparation for publication, provides a set of spatially defined hypotheses that can enable focused interventional studies with the power to establish causal effects.
- 3) When we discussed the results with policy makers and the public in the areas of study, we found that people can perceive the impacts of neighbourhoods on brain functioning and suggest ways that the local areas can be improved to support cognitive health. There was support for the idea of population-level interventions to encourage cognitive health.



## WHAT TO DO NEXT?

- 1) Though here applied to cognition, GeoSPM has utility across the entire domain of spatial analysis, where its simplicity, robustness to noise and limited sampling, and ease of use should, we hope, promote wider recognition of spatial factors in health and disease. The open-source software implementation is available at <https://zenodo.org/record/7258971#.ZF0dm-zMLPY>
- 2) We are collaborating with colleagues who are studying the effects of climate on neurological disease. We are applying our methods to identify cognitive changes in relation to short-term weather extremes.
- 3) We are now planning to calculate the economic impact of these (short-) and long-term effects of pollution on cognition, focusing on inequalities in air pollution between different areas of England (or the UK) to estimate the inequalities in cognition, and then estimate the associated economic inequities.

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