THE IMPACT OF THE ENVIRONMENT AND POLLUTION ON COGNITIVE HEALTH (EPOCH)

BECRP

Behaviour, Environment and Cognition Research Program

Key Investigators

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Background

Lively, high compact, that are rich in leisure and business destinations, provide older populations with opportunities to take part in physical, social, and mental activities that improve their cognitive health- that is their ability to think, learn, reason, and remember. However, these types of environments are also linked to harmful amounts of traffic pollution and noise. Studies integrating the effect of the built environments (manmade structures, features, and facilities that provide the setting for where people live and work, e.g., parks, local services) and the side effects produced by these environments (pollution, noise etc.), are limited. Most often focus on either how the built environment promotes physical activity, or the effect of air pollution in single locations. To properly understand how neighbourhood factors can affect cognitive health it is important to study all positive and negative influences of the environment across a wide range of locations. EPOCH will combine data on the neighbourhood built environment, the natural environment (natural water features, distance to parks, greenness) and pollution (air pollution and noise) from six already existing study groups with existing data to investigate the complex effects of the built environment and pollution on cognition in later life.

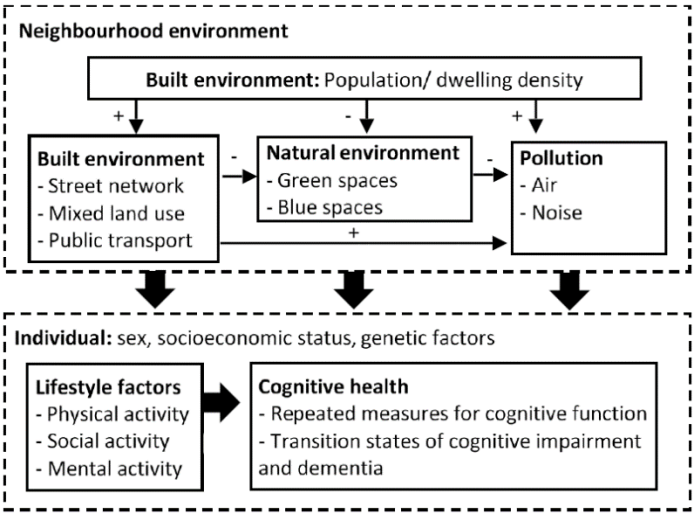

Figure 1: Conceptual framework of the effects of the neighbourhood built environment on cognitive health in later life

Aims

The aim of this project is to provide a deeper understanding into how built environments can support cognitive health and reduce the risk of cognitive decline and dementia. This

project will include a variety of neighbourhood-built environment attributes as well as built environment characteristic (e.g., natural environment and pollution). It will collect data from a large range of geographical locations in Australia and the UK.

The hypotheses established for the study can be seen below (Table 1)

Environmental attributes	**Hypotheses**
Socio-economic status of area	Low socio-economic status is associated with poor cognitive health
Built environment	
Population density	Both low and high population density have negative impacts on cognitive health
Street network	High street intersection density has a positive impact on cognitive health
Land use mix	High level of land use mix has a positive impact on cognitive health
Places of interest	High density of places of interest has a beneficial impact on cognitive health
Public transport	High density of public transport is beneficial for cognitive health
Natural environment	
Green (e.g., parkland) and blue (e.g., lakes) spaces	Better access to green and blue spaces is beneficial to cognitive health
Pollution	
NO2	High levels of NO2, PM2.5 and traffic-related air pollution have detrimental effects on cognitive health
PM2.5	
Traffic-related air pollution	
Noise	High level of traffic-related noise has a detrimental effect on cognitive health

Table 1: Environmental features examined and there hypothesized potential impact on cognitive health.

Methods

This project includes several pre-existing studies involving older populations (Table 2).

UK Studies	Australian Studies
Cognitive function and aging studies (CFAS) Wales CFAS II The English Longitudinal Study of Aging (ELSA) UK Biobank	Older Australian Twins Study (OATS) Personality and Total Health through life project (PATH) Sydney Memory and Aging Study (MAS)

Table 2: The pre-existing study cohorts from the UK and Australia that will be used within the EPOCH project.

Models will be established that enable the synthesis of environmental measures across aging populations.

Procedures will be developed that will allow data on built environments, natural environments, and pollution, to be integrated with country specific Geographical Information system (GIS) data. GIS is a database that geographic data (data for different locations) is combined with software tools that allow for managing, analysing, and visualising the data. Environmental data sets that have been collected using similar methods and the same operating procedures will be used to enhance comparability between Australia and the UK. Street network and straight-line buffers of 0.5km – 1km will be used in the study as these distances are considered walkable for older adults.

Air pollution maps will be developed. As no previous air pollution data has been produced this will be gathered. Two types of air pollutants have previous shown they may be risk factors for cognitive health, and will therefore, be examined in this project. These are fine particulate matter (<2.5 microns) and nitrogen dioxide. Air pollution exposure will be categorized as:

- General ambient air pollution - air pollution from a range of sources including traffic, industry, and nature
- Traffic-related air pollution - air pollution form cars, buses, and trucks

Noise pollution in the UK will be obtained from there previously developed noise map, published by Defra. This provides a snapshot of the estimated noise across England. In Australia no noise maps are available and therefore noise pollution will be assessed using proxy measures (e.g., train line densities, aerial distances to nearest busy road etc.,)

Investigating the impact of the neighbourhood-built environments and built environment-related environmental factor on cognitive health in later life

The total, indirect (effected by other factors), and direct (independent of other factors) effects of environmental factors on cognitive health in later life (Figure 1) will be assessed to determine their beneficial and harmful impacts. This study will look at whether recent environmental factors are associated with cognitive impairment or increased cognitive decline as well as the calmative effect over of exposure of the last 15 years. Looking at calmative exposure will allow us to investigate the direct and indirect effects of environmental factors on cognitive health. Older people who have moved within the last four years will be excluded from the study.

Lifestyle factors:

Lifestyle behaviours can be affected by the characteristics of the built and natural environment and pollution and have been linked to cognitive decline. Analyses that include measures for physical activity, social activity and mental activity will be conducted. Baseline measurements and follow up measurements of these characteristics will be integrated into our analytical framework and GIS and the indirect effects of the environment on cognitive health via lifestyle behaviours will be estimated.

Sex, genetics, and socio-economic status:

The study will investigate whether the same environmental factors have different effects men and women, and people with different socio-economic status (measured by education, occupation, or income). The project will also examine the modifying effect of the APOE genotype, a known genetic risk factor for dementia, on the level of vulnerability to adverse environmental conditions

Integration and investigation of cross-country relationships

Results from different studies will be integrated using a model that synthesizes the data. This will allow us to investigate cross-country variation and the investigation of region-specific effects

Benefits for society

This project will explore the total, indirect (mediated by other factors), and direct (independent of other factors) effects of the environmental factors on changes in cognitive health. This information is important as it can help identify pathways for prevention that may help lessen the negative effects and has several policy implications.

For example, as densification (increase in population) is the main driver of other environmental changes (Figure 1) it is important to understand its total (direct plus indirect) impact on cognitive health to inform regulatory urban planning policies.

It is also necessary to estimate the direct and indirect effects of densification on cognitive health to distinguish between its potentially beneficial and harmful effects and identify pathways that lessen the harmful effects, such as transportation policies that reduce air and noise pollution by limiting motorized traffic in residential areas.