

Introduction to Causal Loop Diagrams (CLDs)

24th January 2024



Ione Avila-Palencia, PhD, MPH

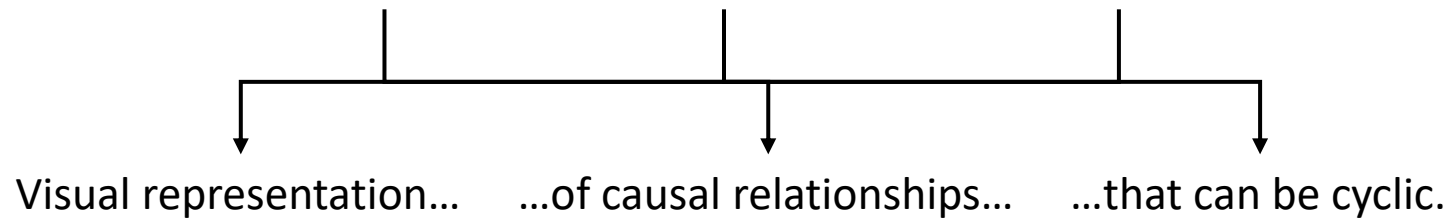
Centre for Public Health, Queen's University Belfast



Outline

- Causal Loop Diagram (CLD)
- Real example: SPACE Project

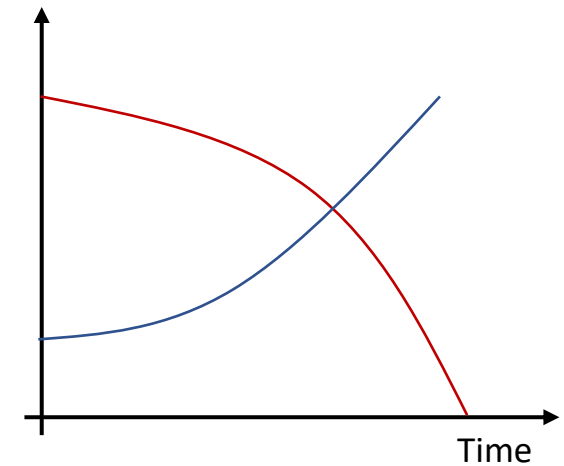
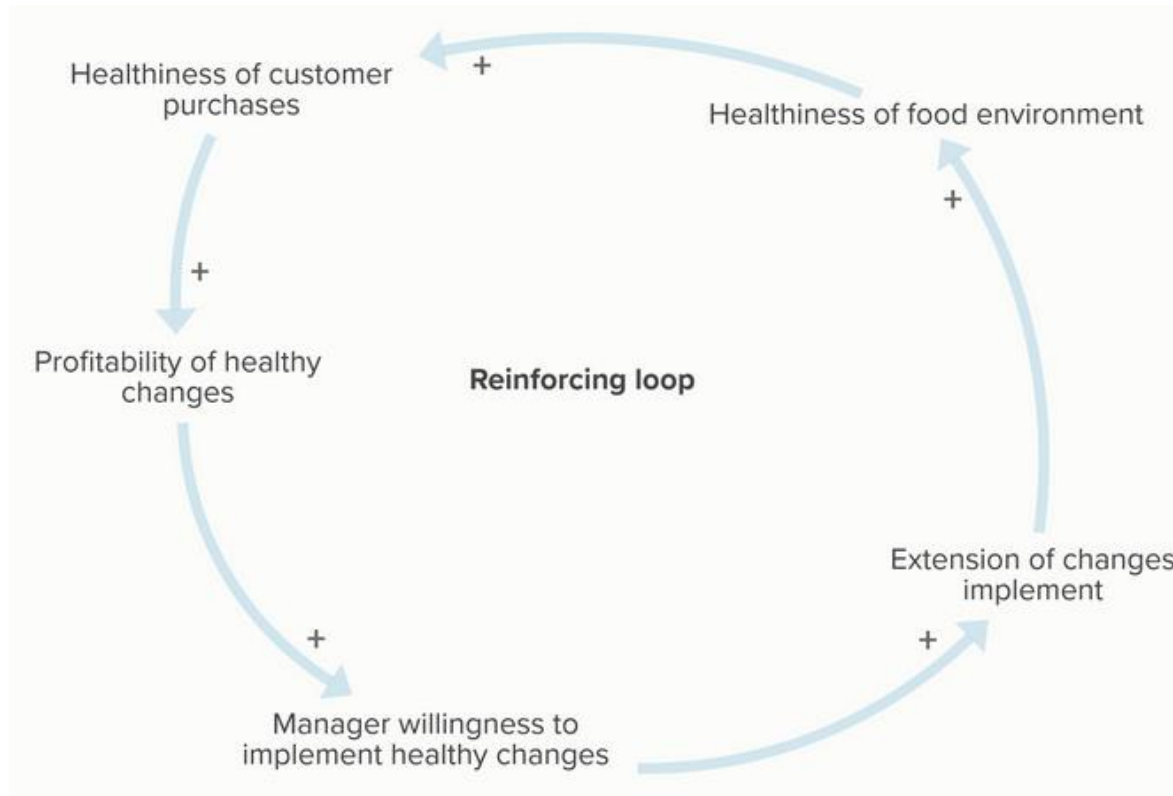
Causal Loop Diagram



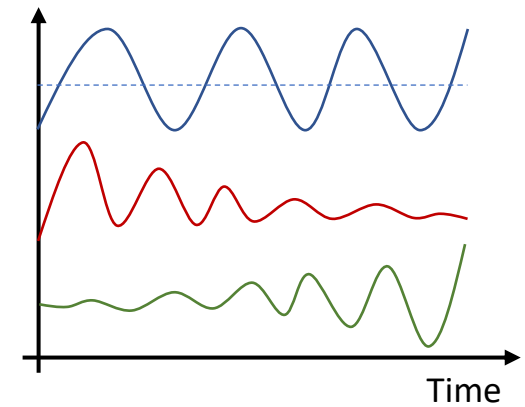
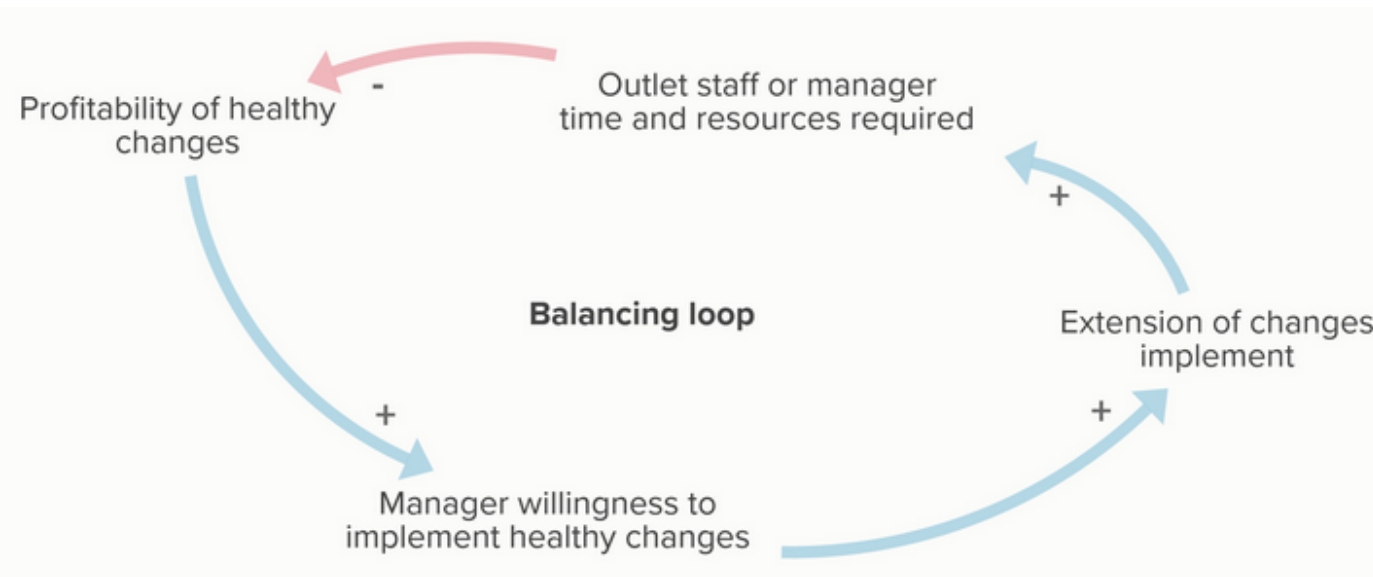
Factors & connections



Feedback loops



Feedback loops





Real example: SPACE Project

This work was supported by **UK Research and Innovation** [ES/V016075/1]



SPACE Project

- Aim:
 - **to investigate the impacts**, and possible mechanistic pathways, **of urban environments on healthy ageing and the cognitive health** of diverse individuals and communities, through the novel integration of multi-omics, behaviours, environmental exposures, and urban environment, to create healthy active places that are supportive, attractive, and accessible to people as they age across the life course.
- This research builds on several projects:



Research questions

1. **What are the plausible causal pathways** within the environment-based systems perpetuating cognitive decline, including those **between the urban environment**, its related environmental exposures, lifestyle behaviours (i.e. social engagement, physical activity), biological factors **and cognitive health**?
2. Using newly curated environmental NI exposure data, what is the effect, and mechanistic pathways, of urban environment and related environmental exposures on cognitive health and lifestyle behaviours?
3. Using exploratory multi-omic approaches, what are the biological responses to the urban environment and related environmental exposures influencing measures of cognitive health?
4. What prevention strategies, policies and interventions might help prevent cognitive decline, promote cognitive health, and reduce cognitive health inequalities?

Group Model Building

A process in which team members exchange their perceptions of a problem

A participatory method for involving people in a modelling process

A space where experts co-create a shared understanding of the complex system influencing cognitive health



Group Model Building workshop

Problem of interest

Better understand the mechanistic pathways by which urban environment impacts cognitive health in older adults



Objectives

1. To enable the SPACE team experts **to develop a system-based**, evidence-informed knowledge synthesis **diagram** to identify established and potential determinants of MCI and dementia in older adults

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2. **To identify the underlying mechanisms**, including direct and indirect pathways, between urban environment factors and MCI and dementia in older adults

Objectives

1. To enable the SPACE team experts **to develop a system-based**, evidence-informed knowledge synthesis **diagram** to identify established and potential determinants of MCI and dementia in older adults
2. **To identify the underlying mechanisms**, including direct and indirect pathways, between urban environment factors and MCI and dementia in older adults
3. **To build a shared understanding** of the complex system influencing MCI and dementia in older adults.

Group Model Building workshop

Participants:

- A total of 12 experts from 10 disciplines participated in the workshop.
- All participants provided informed written consent.



**Prof Bernadette
McGuinness**



Prof Peter Passmore



Prof Frank Kee



Prof Geraint Ellis



**Prof Trung
Duong**



Dr Claire Cleland



**Prof Jenny
McKinley**



Prof AJ McKnight



**Prof Dermot
O'Reilly**



Prof Ruth Hunter



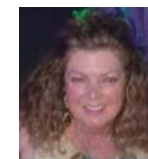
Dr Leandro Garcia



**Dr Ione
Avila-Palencia**



Conor Meehan



Roisin Corr

Group Model Building workshop

General workshop structure:

- The 2-day workshop took place in two online sessions (two hours each) using Microsoft Teams.

Session 1: 6th December 2021, 13-15h

Session 2: 7th December 2021, 13-15h



Microsoft Teams



Kumu.io



Agenda Session 1 (2h00min)

Time	Activity	Description
5 min	Welcome and introductions	<ul style="list-style-type: none"> • Introduction of facilitation team • Summary of workshop goals • Agenda for the day • Expectations and commitments • Note taking • Informed consent
5 min	Problem articulation	<ul style="list-style-type: none"> • Define problem to be addressed
5 min	Conceptual framework review	<ul style="list-style-type: none"> • Overview of the conceptual framework presented in the project proposal
10 min	Introduction to systems thinking and causal loop diagram (CLD)	<ul style="list-style-type: none"> • Introduction to systems thinking and causal loop diagrams
5 min	Introduction of NICOLA/HCAP variables	<ul style="list-style-type: none"> • Introduction of the different measures used in NICOLA/HCAP projects
10 min	Agreement on key outcomes of interest <ul style="list-style-type: none"> - Dementia - MCI 	<ul style="list-style-type: none"> • Ask experts to discuss about implications of different measures grouping
10 min	Break	
60 min	Model Building	<ul style="list-style-type: none"> • Instructions (5min) • Identification of variables and connections (55 min)
10 min	Next steps and closing	<ul style="list-style-type: none"> • Explain what is next • Thank participants

Group Model Building workshop

Model building:

- Identify factors
- Draw connections
- Disagreements
 - When disagreements occurred, were discussed until arrived at a middle point. In some cases, the disagreements were due to proposals of factors from different perspectives (theory versus data oriented)



Group Model Building workshop



Between session 1 and 2 :

- CLD refinement by the facilitation team

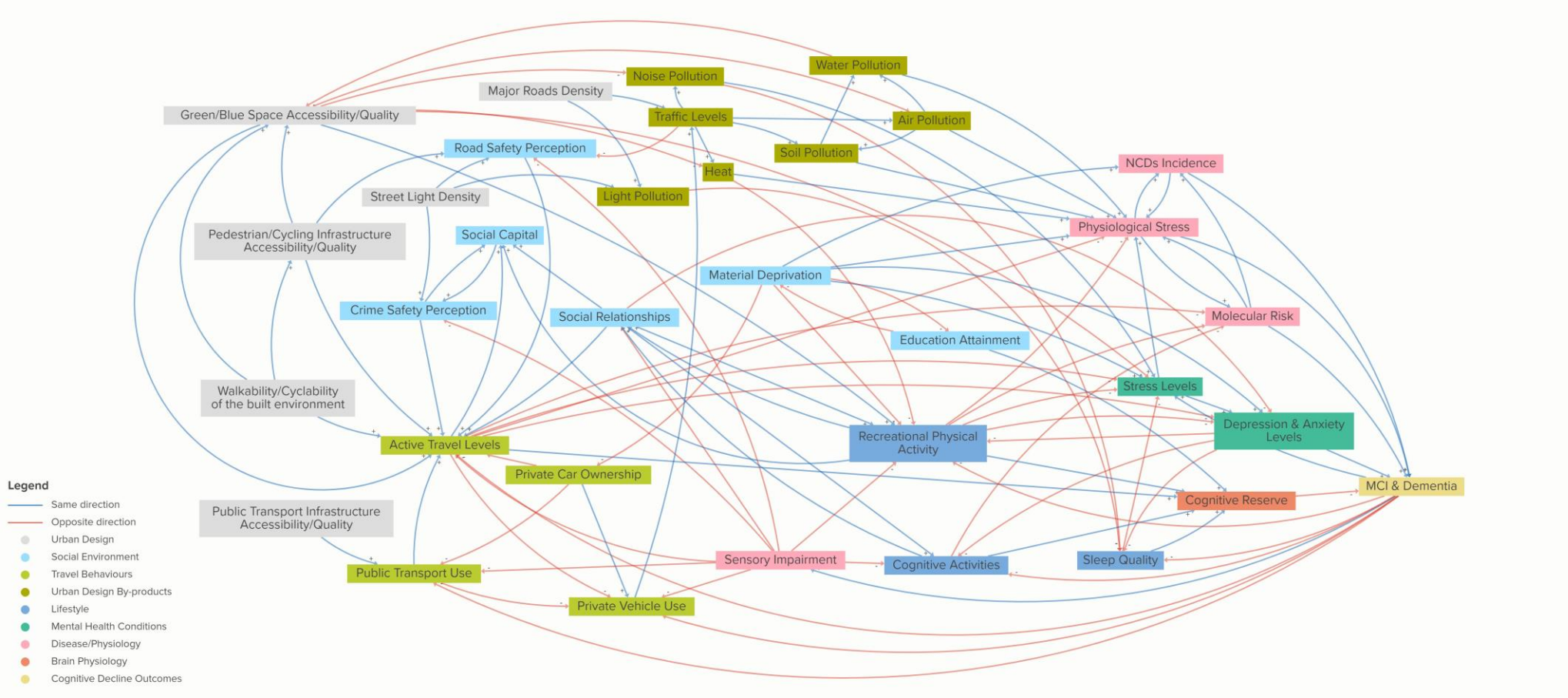
Agenda Session 2 (2h00min)

Time	Activity	Description
5 min	Welcome and introductions	<ul style="list-style-type: none"> • Introduction of facilitation team • Summary of workshop goals • Agenda for the day • Expectations and commitments • Note taking • Informed consent
60 min	Model building	<ul style="list-style-type: none"> • Diagram session 1 description (5 min) • Discussion (55 min)
10 min	Break	
40 min	Model building/review	<ul style="list-style-type: none"> • Diagram description (5 min) • Discussion (35 min)
5 min	Next steps and closing	<ul style="list-style-type: none"> • Explain what is next • Thank participants

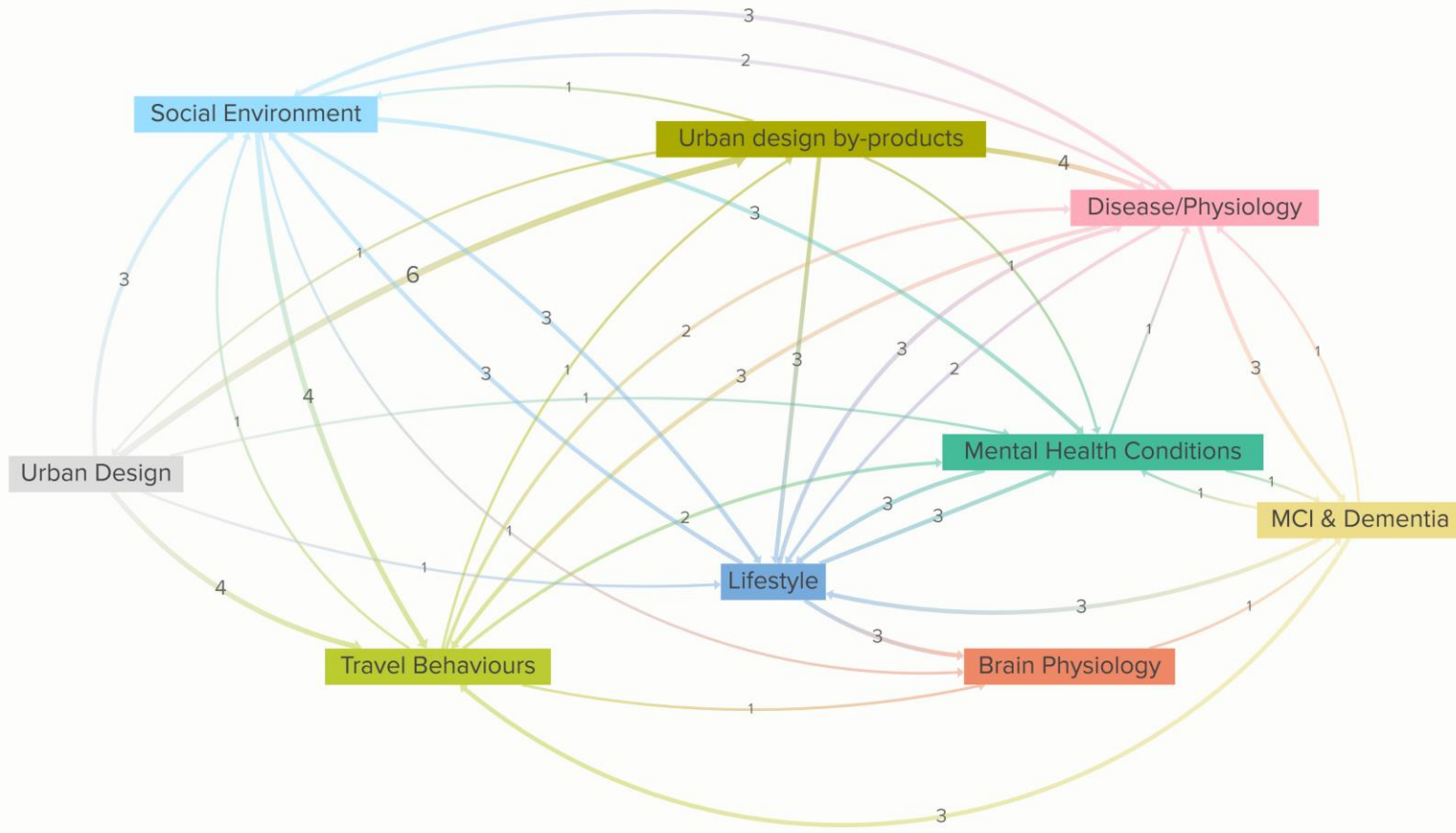
Debrief & Refinement Process

- Debrief session
 - Facilitators & modeller
- Refinement process
 - Facilitators reviewed the CLD
 - In each meeting a different theme was reviewed
 - Once all the different themes were reviewed, the team reviewed:
 - the polarity of the arrows
 - the consistency of terminology used
 - the connections for coherency
 - CLD Simplification

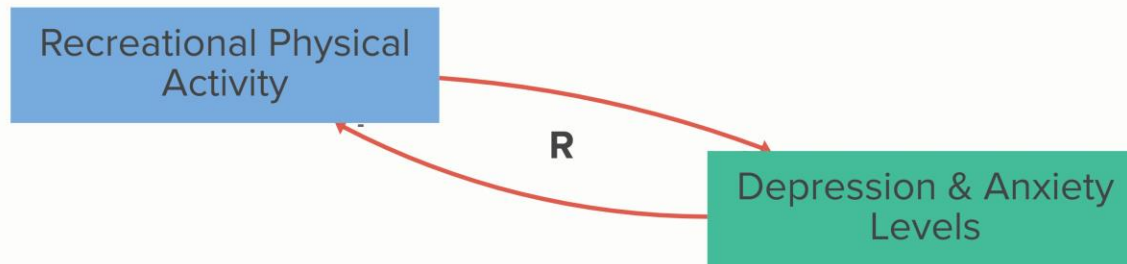
SPACE Causal Loop Diagram



SPACE Causal Loop Diagram

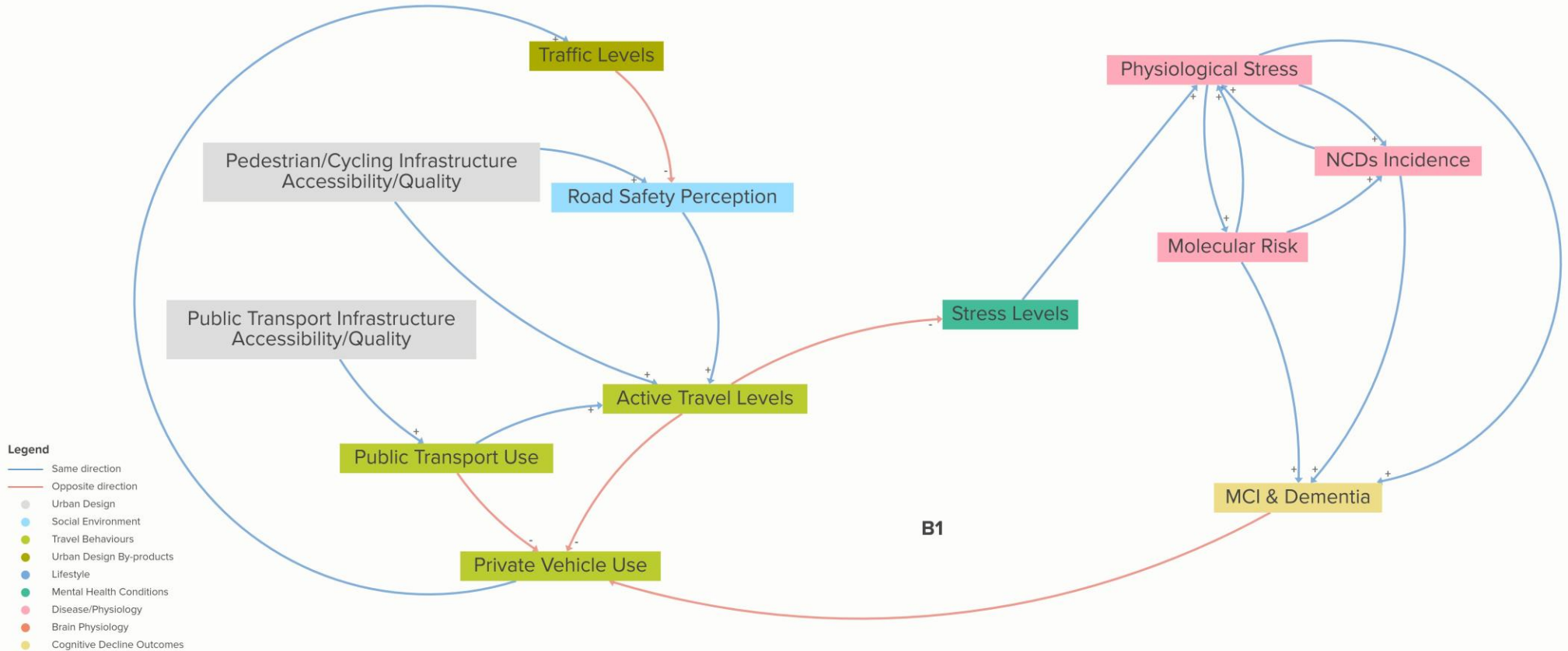


SPACE Causal Loop Diagram



- Legend**
- Same direction
 - Opposite direction
 - Urban Design
 - Social Environment
 - Travel Behaviours
 - Urban Design By-products
 - Lifestyle
 - Mental Health Conditions
 - Disease/Physiology
 - Brain Physiology
 - Cognitive Decline Outcomes

SPACE Causal Loop Diagram













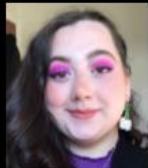













Contact us:

E-mail: space@qub.ac.uk

Twitter/X: @spacequb



qub.ac.uk/sites/space

								
Ruth Hunter Principal Investigator	Bernadette McGuinness Principal Investigator	Leandro Garcia Co-Investigator	Jennifer McKinley Co-Investigator	Ione Avila-Palencia Research Fellow	Amy Jayne McKnight Co-Investigator	Trung Q Duong Co-Investigator	Sean O'Neill Research Fellow	Shay Mullineaux Research Assistant
								
Geraint Ellis Co-Investigator	Claire Cleland Research Fellow/ Co-Investigator	Sophie Glover PhD Student	Katie Quinn Technician	Frank Kee Co-Investigator	Maciej Domanski Database Systems and IT Security Senior Technician	Mike Trott Research Assistant	Dermot O'Reilly Co-Investigator	Roisin Corr Project Administrator
								
Joanna McHugh Power Co-Investigator	Gemma McNickle Embedded Researcher (OSNI)	Fareena Naz PhD Student	Yogesh Gupta Research Fellow	Ruoyu Wang Research Fellow	Niamh O'Kane Research Fellow / Science Communication and Research Impact Officer	Hüseyin Küçükali Research Fellow		

THANK YOU!



i.avila-palencia@qub.ac.uk



[@ioneavpa](https://twitter.com/ioneavpa)



SPACE

SUPPORTIVE ENVIRONMENTS FOR
PHYSICAL & SOCIAL ACTIVITY,
HEALTHY AGEING & COGNITIVE HEALTH

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Economic
and Social
Research Council



Healthy Ageing Challenge
Social, Behavioural and
Design Research