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Systems approaches to public health evaluation

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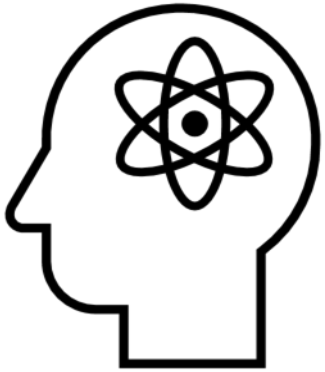
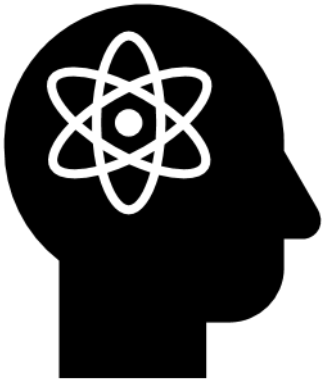
Part I: Why apply a systems perspectives to public health evaluation

Two ways of considering complexity

Complex Interventions

Public health community has been interested in this for a number of decades.





Complex Systems

Public Health Community recently become more interested in this (but other disciplines have had a longer interest).

MRC/UKRI Guidance defines complex interventions as having…

- Several interacting components
- Multiple groups or organisations involved in delivering and receiving the intervention.
- Multiple behaviours on the part of those delivering and receiving
- Numerous outcomes
- Degree of flexibility or tailoring of the intervention permitted

https://mrc.ukri.org/documents/pdf/complex-interventions-guidance/

Complex system

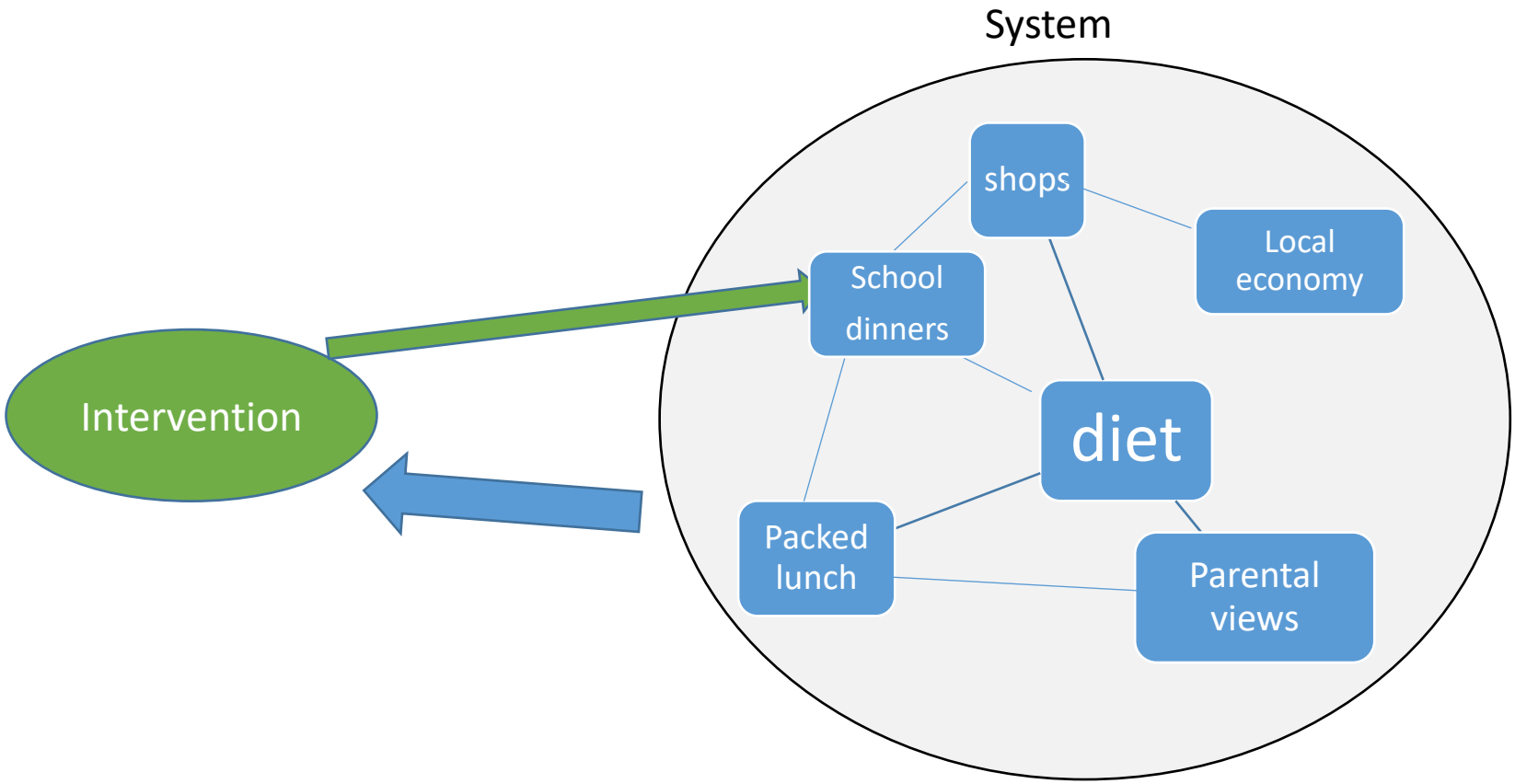
"a set of things – people, cells, molecules or whatever – interconnected in such a way that they produce their own pattern of behaviour overtime" (Meadows 2008, p.2)

Key attributes of a **complex** system

- 'produce their own pattern of behaviour'
  - A system is more than the sum of its parts – new patterns can **emerge** from it
- Self-organising rather than centrally organised
- 'Over time' – the system is **dynamic** and time sensitive
- So, complexity is **more than just a tangled set of relationships**. Its about a system that behaves in a certain way.

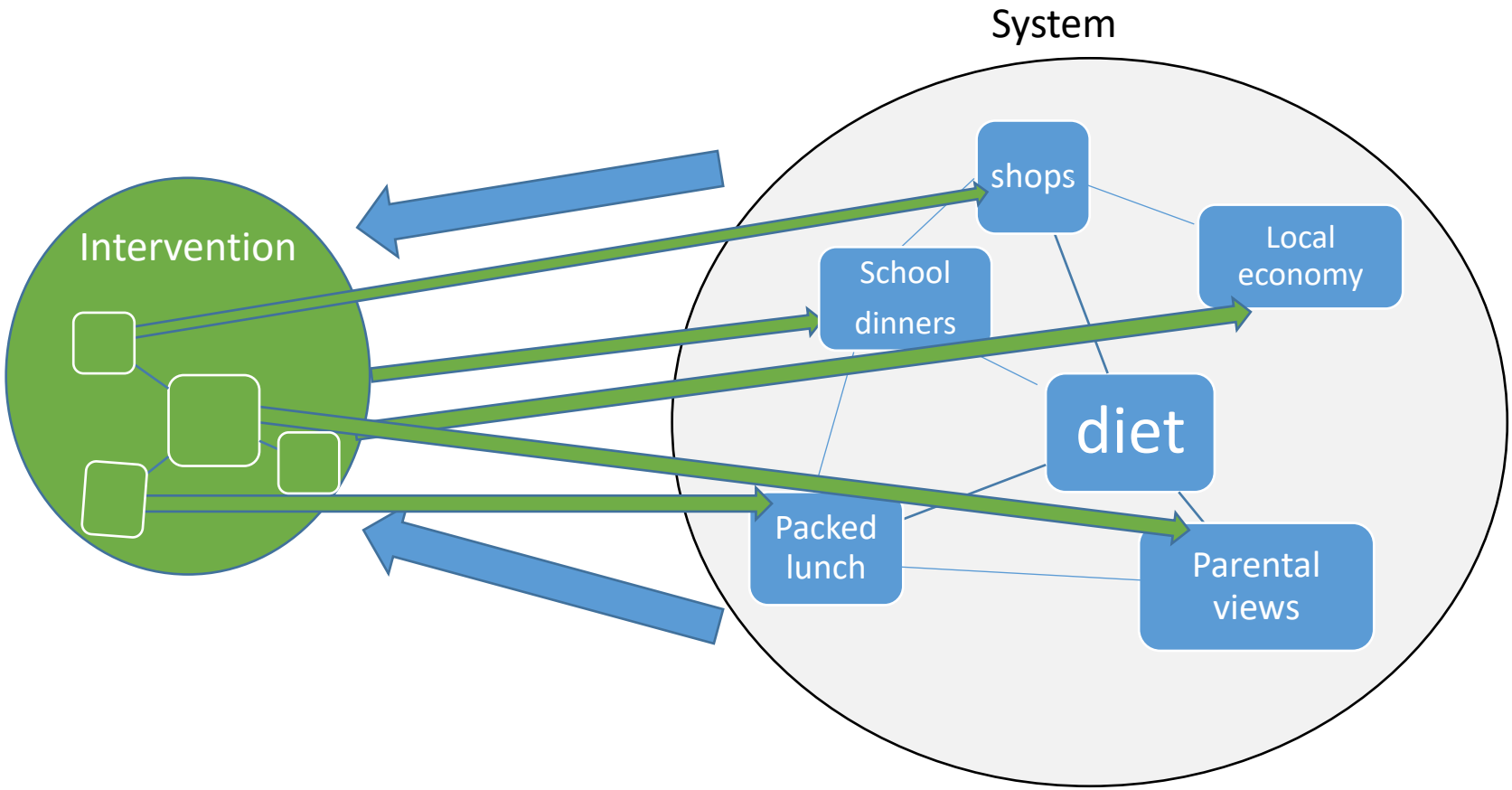
Intervening in a complex system

(Simple intervention)



Intervening in a complex system

(complex intervention)



Why apply a systems perspective?

A systems perspective involves "Consideration of the ways in which processes and outcomes at all points **[…and at different levels…]** *within a system drive change. Instead of asking whether an intervention works to fix a problem, researchers should aim to identify if and how it contributes to reshaping a system*" (Rutter et al., Lancet 2017)

What can a systems perspective add to evaluation?

- '**System Map**': how the different parts (people, organisations, interventions) of the system relate to each other and how those relationships can change:
  - Visualise those perspective
  - Compare and contrast across different stakeholders

- The **Big Picture**: e.g.
  - Activities that '**swim against the tide**'?
  - **Who's interests** are being served by specific approaches?
  - **Stepping stones** – small activities that could lead to larger initiatives

- More comprehensive understanding of **impacts**
  - **Larger range** of impacts – both anticipated and unanticipated
  - Understanding what **amplifies** or **dampens** those impacts (feedback loops)

- Complex **causal pathways** and **alternative pathways**

Part II: How do we apply a systems perspective to evaluation?

Some methods

May be useful to think of two different ways to approaching systems methods

Draw on systems and complexity **methods**

- Use methods rooted in systems and complexity sciences that were developed to answer systems questions

Draw on systems and complexity **theory**

- Use systems thinking as a **heuristic** or **thinking tool**
- Apply to established methods

What you choose to do will depend on your **research question**

Summary

Stages of evaluation	Aim
Theorising	Identify and compare stakeholder understandings of a system.
	Identify and compare stakeholder understandings of how a planned intervention might interact within a system.
Prediction	Hypothesise and simulate how the intervention may impact on and interact with the system
	Hypothesise and simulate how agents within the system might react and interact in response to an intervention
Process evaluation	Understand how an interaction has impacts within the system in the real world, including impacts of variation in local context
Impact evaluation	Quantify the impact of the intervention on key system parameters in the real world
Further prediction (extension of impact evaluation)	Hypothesise and simulate how the intervention may impact the system over a longer time horizon or in a different context.
	Hypothesise and simulate how agents within the system might react and interact in response to an intervention over a longer time horizon or in a different context.

McGill et al 2021. *Social Science and Medicine*

Summary

Stages of evaluation	Aim	System mapping	Network analysis	System modelling	System framing
Theorising	Identify and compare stakeholder understandings of a system.	•			•
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Prediction	Hypothesise and simulate how the intervention may impact on and interact with the system			•	
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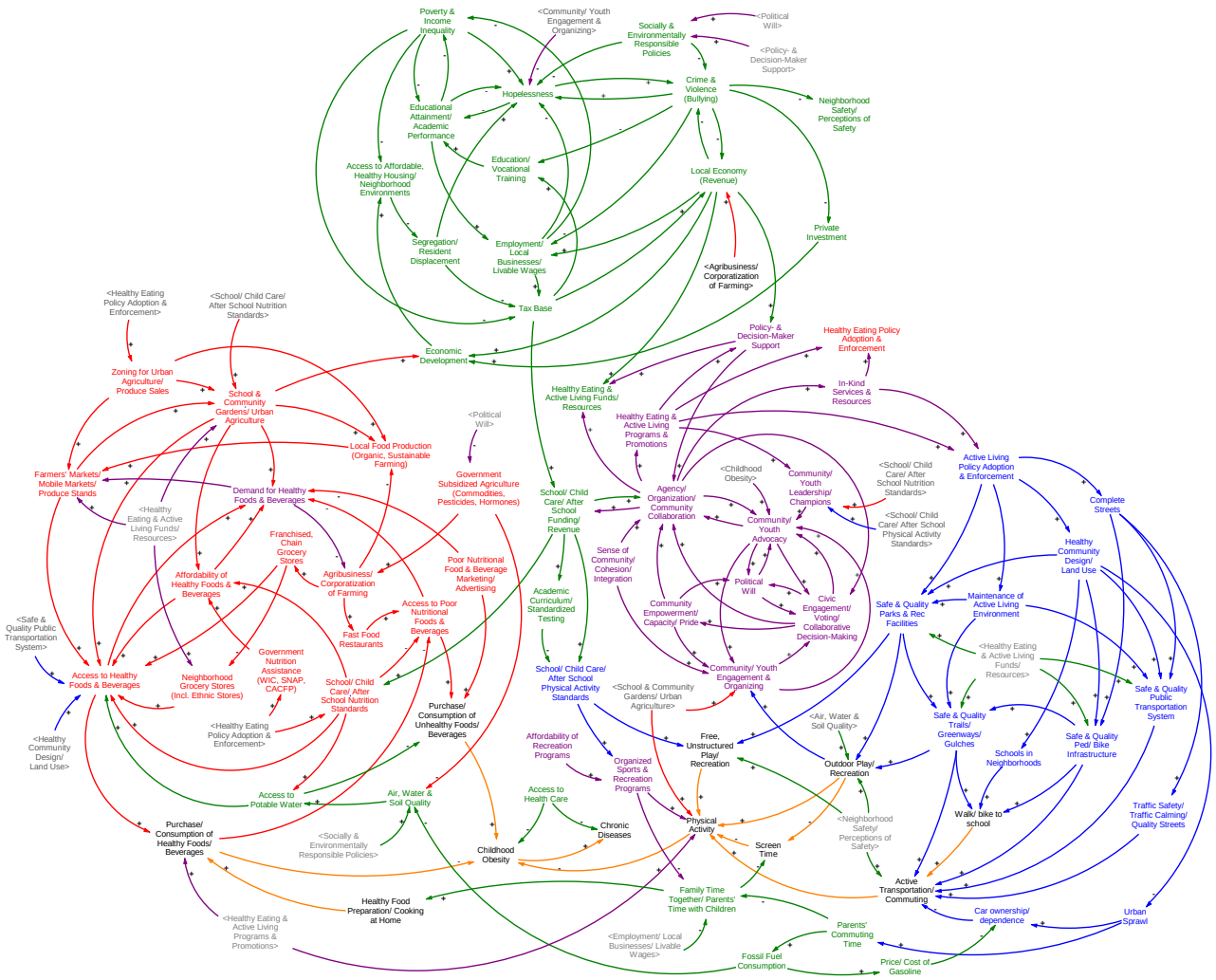
McGill et al 2021. *Social Science and Medicine*

System mapping

- Use for **theorising** the system of interest and the possible ways the intervention may lead to changes **across the system**
- Integrate perspectives from across the system
- Range of mapping methods:
  - Mind maps
  - Concept mapping
  - Group model building (behaviour-over-time graphs; causal loop diagrams)
  - Stock and flow diagrams (used in system dynamics modelling)

System mapping - example

- Intervention to implement healthy eating and active living policy, systems and environmental changes for children
- Developed with range of stakeholders across the system
- Visualised the community's theory of change
- Used to identify points to intervene in the system and reinforce what worked well



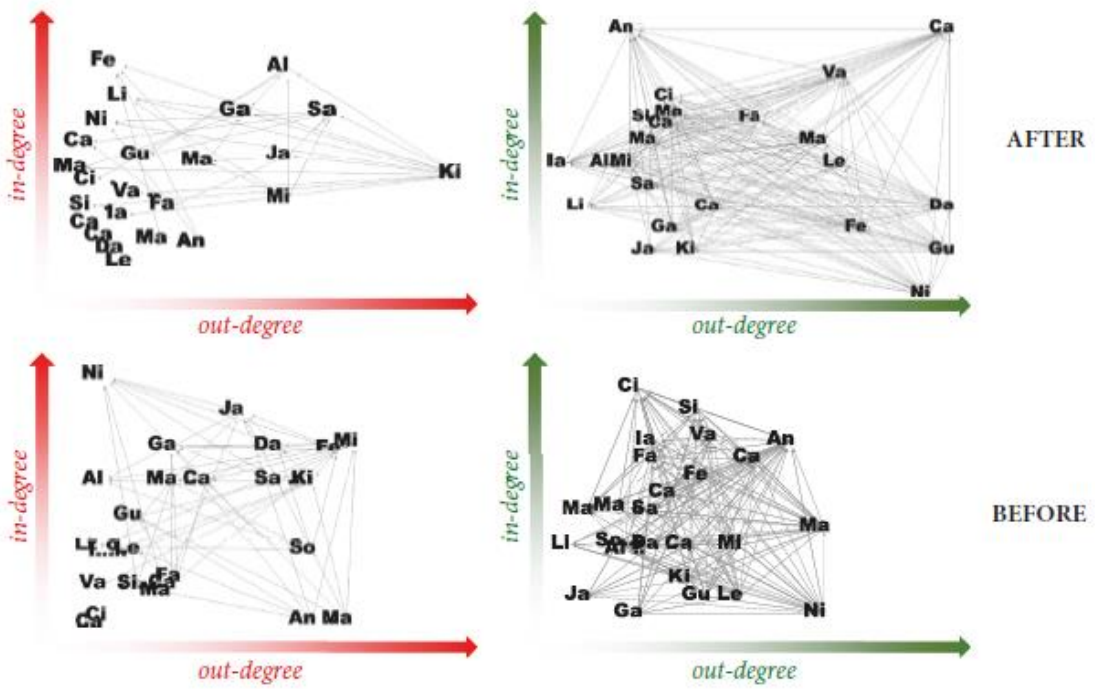
Brennan et al (2015)

Network analysis

- Use to understand **implementation mechanisms** or to **quantify impact of the intervention** on key system parameters:
  - Which parts of network best placed for affecting change
  - Effectiveness of interventions aimed at networks
  - How to strengthen or maintain interventions overtime
- Emphasis on the relationships between individuals and organisations within a system

Network analysis – example

- Mindfulness and cooperation intervention in children
- Pre-post design with experiment and control groups
- Assessed social network diversity and quality of positive relationships



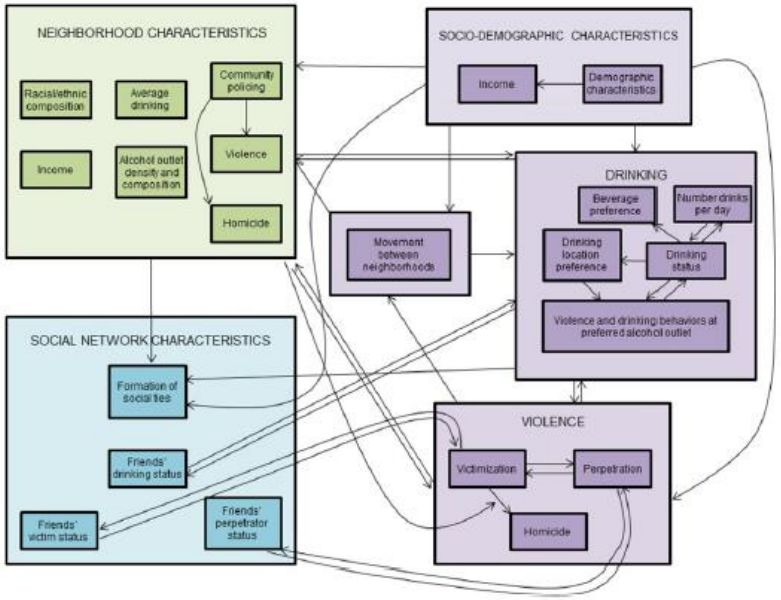
Fuentes et al (2018)

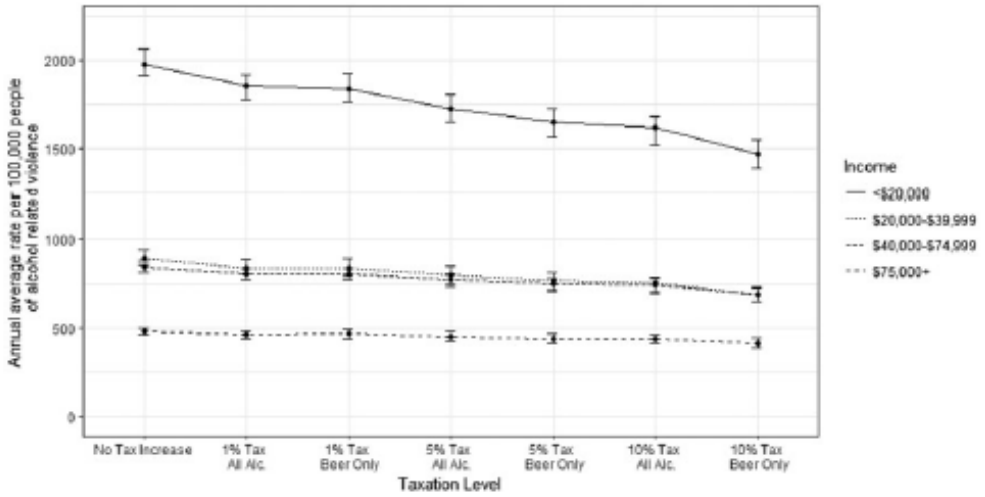
System modelling

- Use for **predicting** how:
  - An intervention may impact on or interact with a system
  - How agents may react and respond to an intervention
- Can simulate impact of hypothetical or planned intervention (or compare several scenarios)
- Can simulate how an implemented intervention will have impacts over a **longer timescale** or **in a different context**
- Range of methods:
  - Agent-based modelling
  - Systems dynamics modelling
  - Micro-simulation
  - Others

System modelling - example

- Agent-based model
- Assess the impact of alcohol taxation on rate of violent victimisation
- Tested multiple scenarios





Keyes et al 2019

Figure 3 Estimated annual average rate of alcohol related violence by income and level of taxation in an agent-based model of New York City

System framing

- Use systems thinking to **frame** an evaluation and then draw on existing methods
- Use to:
  - Develop evaluation questions
  - Theorise the system of interest and possible system-wide theories of change
  - Evaluate implementation mechanisms and unintended consequences
  - Quantify system-level impacts

System framing – example

- Evaluation of the Public Health Responsibility Deal
- Used systems framing as a way of integrating data from several evaluation strands

Table 1. Components of the Public Health Responsibility Deal (RD) evaluation, and aspects of the system which they shed light on.

RD Evaluation Components	System Attributes which these Data Illuminate (Adapted from [20])
Logic model built on initial description of how RD would work [23], and scoping review [12]	Causal pathways within the RD systems (food, alcohol, physical activity, health at work)
Participant interviews [9] Analysis of organisational case studies including documents and interviews Media analysis [24]	Structures and processes in place Interests at play Feedback loops, and barriers to change
Qualitative systems dynamic modelling [15,25,26] using Causal Loop Diagrams (as an analytic tool) [27] built on data from pledge analyses, progress report analyses, qualitative data from interviews and organisational case studies (created as part of the current paper)	Drivers, interests, ways of working
Analysis of RD pledges [4–11,13,24]	
Analyses of evidence base [4–11,13,24]	Probability of system changing in response to specific pledges
Analyses of specific pledges [4–11,13,24]	Identifying whether change happened in a particular part of the system

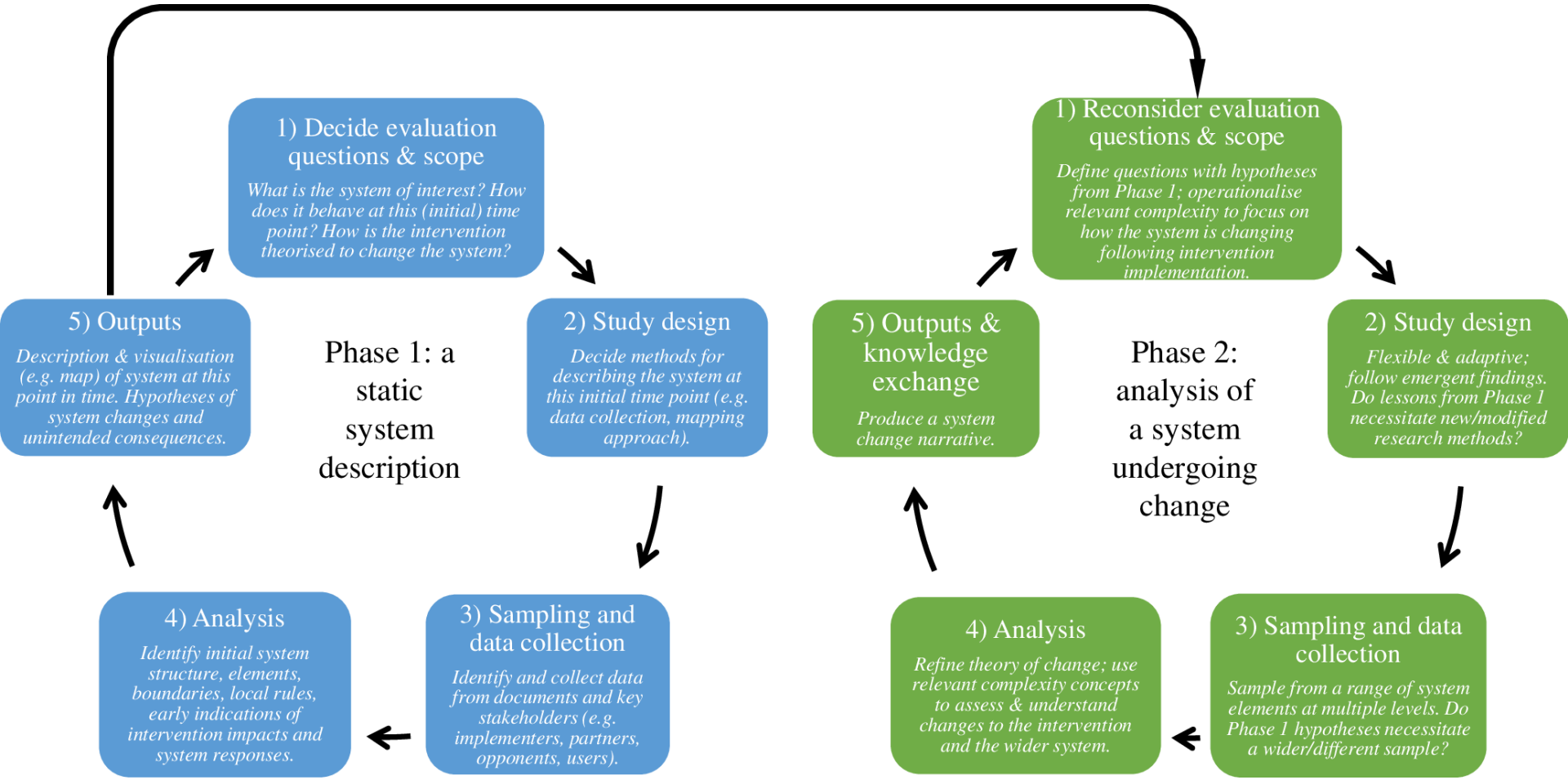
Knai et al 2018

Part III: Process evaluation from a complex systems perspective

Process Evaluation

- Conducted alongside, or independent from, an *impact/outcome* evaluation
- "Can be used to assess fidelity and quality of implementation, clarify causal mechanisms, and identify contextual factors associated with variations in outcomes" (Moore et al 2015)
- From a complex systems perspective:
  - Set of conceptual and methodological tools to guide an evaluation and move beyond immediate implementation, acceptability and uptake
  - Forefronts the system into which the intervention is introduced
  - Emphasis on the *non-linear* ways an intervention may lead to *multiple* impacts
  - Considers both *intended* and *unintended* consequences

Framework for a process evaluation from a complex systems perspective



McGill et al (*PloS Med*).

Phase 1: a static system description

- Guiding questions:
  - What is the system of interest?
  - How does it behave at the initial timepoint?
  - How is the intervention theorised to change the system?
- (Possible) Data collection methods: documentary analysis; interviews; mapping exercises, etc.
- Analysis: identifying system structure (including its elements and boundaries); local rules, theories of change
- Outputs:
  - Description and visualisation of system
  - Hypotheses about how the intervention may lead to system changes

Phase 2: analysis of a system undergoing change

- Use outputs of Phase 1 to develop Phase 2 research questions
- More structured period of data collection (drawing on a range of methods)
- Be flexible and open to emergent findings
- Use concepts from complexity sciences to structure analyses (e.g. feedback loops, adaption, co-evolution emergent outcomes, etc.)
- Outputs: account of how the intervention embeds in the system and the ways in which the system and the intervention adapt in response

A worked example: a process evaluation of the Late Night Levy

- English context:
  - Alcohol misuse is largest risk factor for poor health and early mortality for those aged 15-49
  - Alcohol licensing controlled by local authorities (of which there are 334)
  - Local authorities have access to a range of *discretionary measures* to prevent and address alcohol-associated harms

- The Late Night Levy (LNL):
  - Intervention which charges alcohol retailers who are licensed to sell alcohol between midnight and 6 am an addition fee
  - Fee used for policing and managing the night-time economy
  - Aim to address crime, anti-social behavior and disturbance
  - Implemented in 11 local authorities

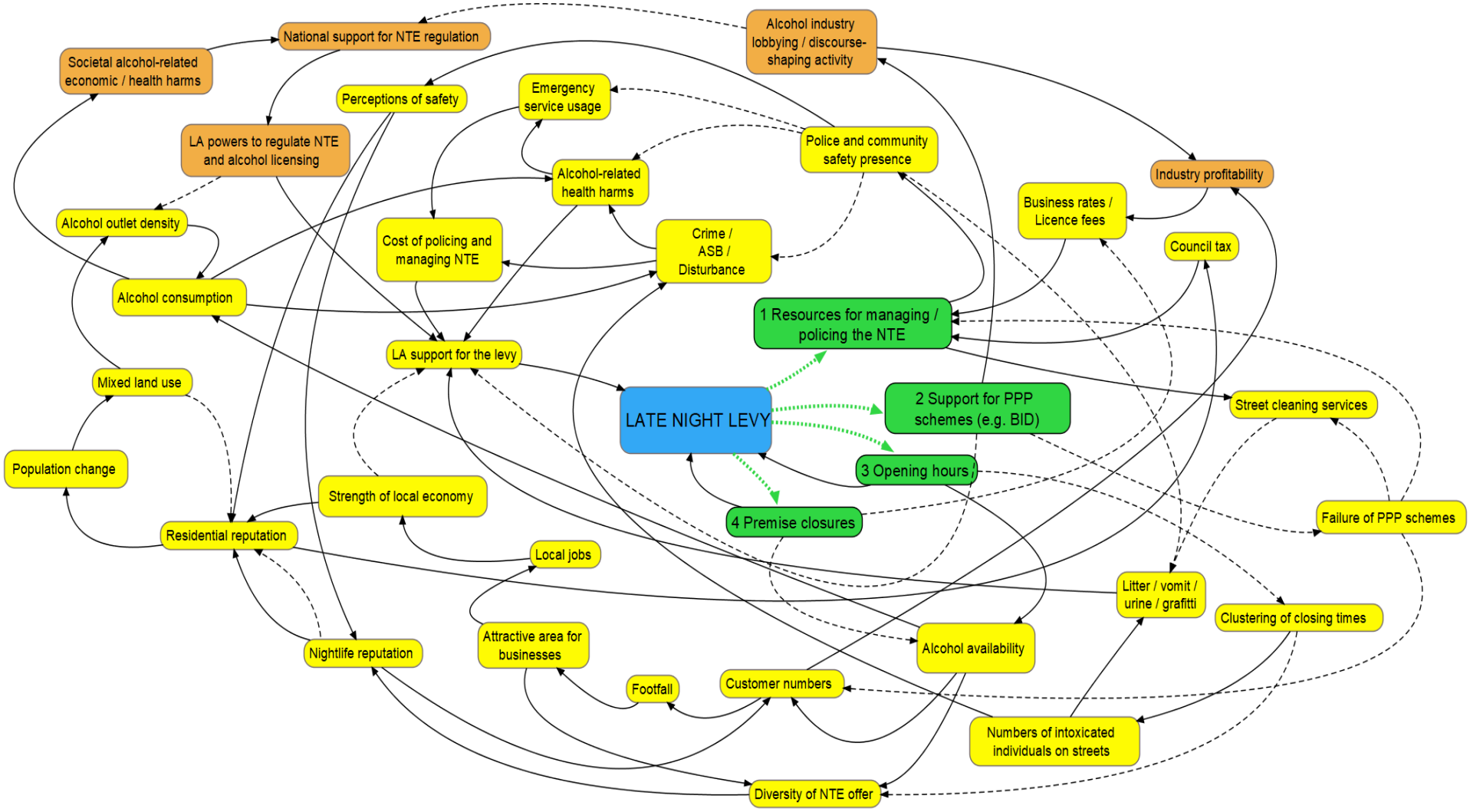
Process evaluation of the LNL in one London Local Authority

- Levy implemented in 2014: used to fund a new 4 person community-safety patrol which operates Thursday – Sunday (8 pm – 8 am) and fund additional police officers to focus on the night-time economy

- Phase 1: period prior to implementation:
  - Review of national and local documents
  - System description and theories of change

- Phase 2: first two years of levy implementation:
  - Review of local documents
  - Interviews with those implementing and delivering the levy
  - Interviews with users of the night-time economy
  - Observations of community-safety patrols
  - Used theories of change to guide analysis

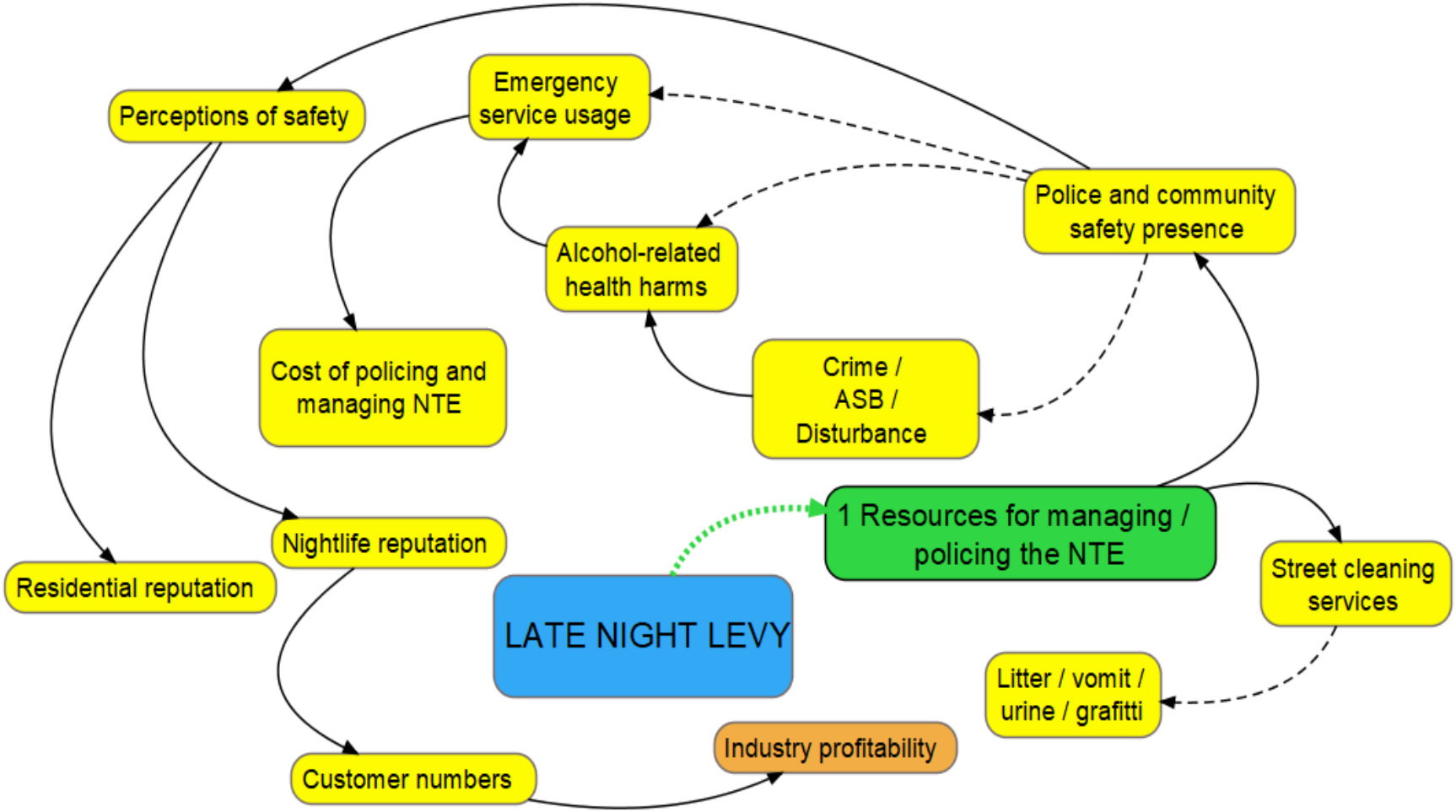
Phase 1: system map



Orange bubbles = national variables; Yellow bubbles = local variables; Green bubbles = immediate theorised impacts stemming from levy introduction

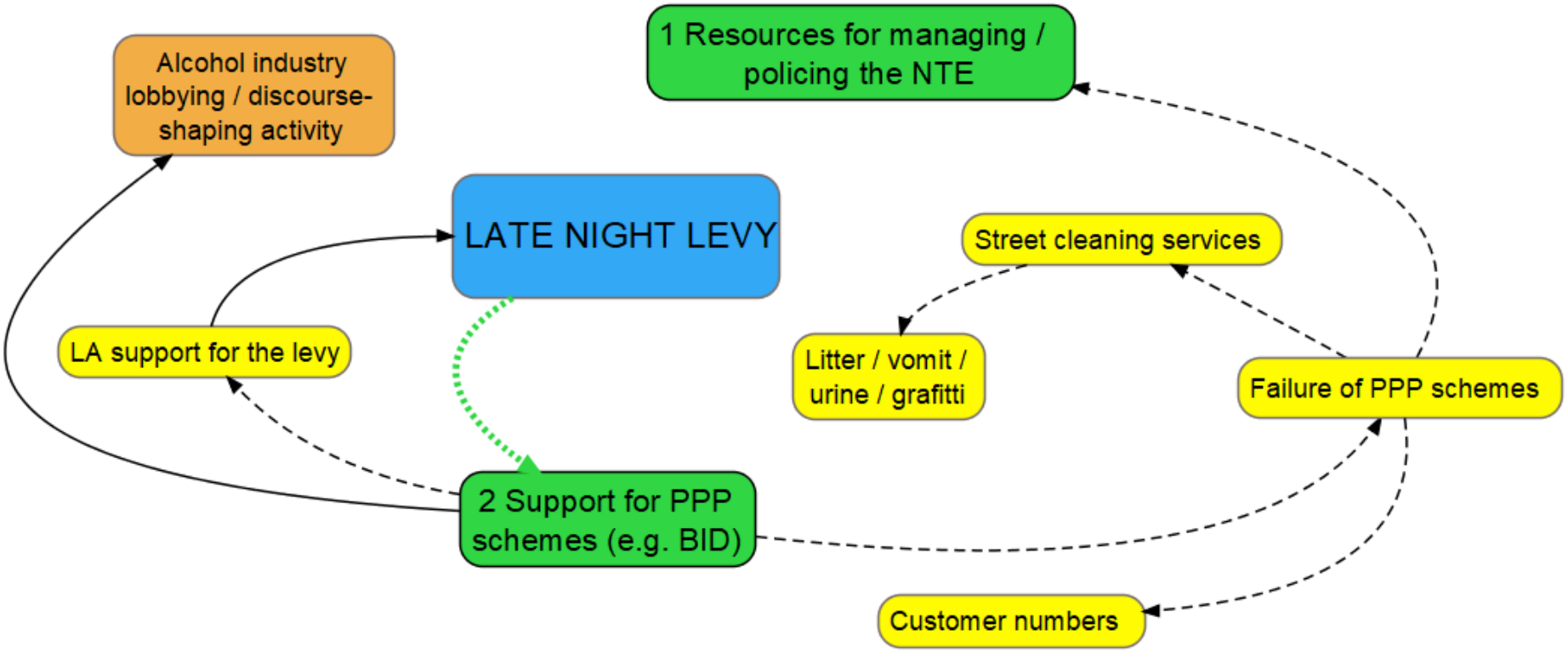
Solid line: positive relationship between variables; Dashed line: inverse relationship between variables; Dotted green line: theorised impacts stemming from the levy introduction

Theory of change 1: increased resources



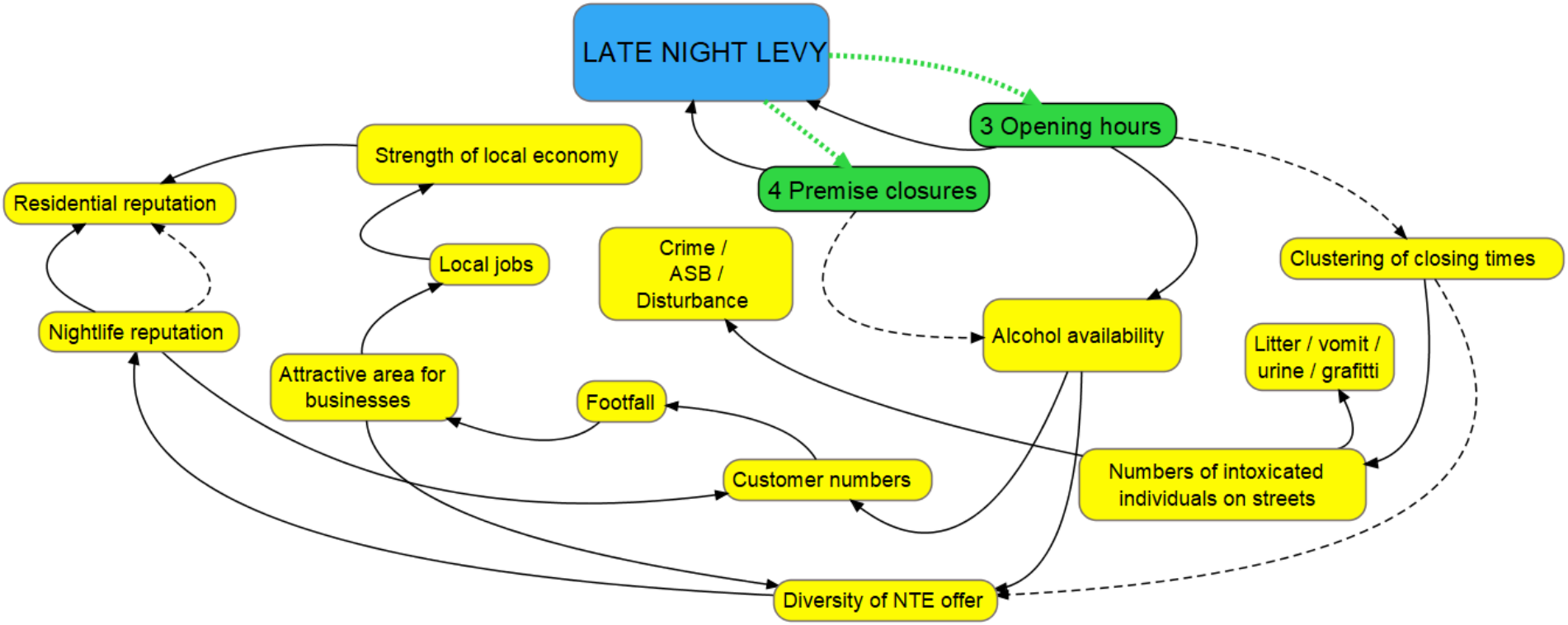
I live on a side street of a late licensed premise and am woken up between 2 am and 7 am regularly every Saturday and Sunday morning. I don't think they realise the noise they're making so if there was a police presence I don't think they'd be as boisterous. (Consultation response, resident)

Theory of change 2: reduced support for public-private partnership schemes



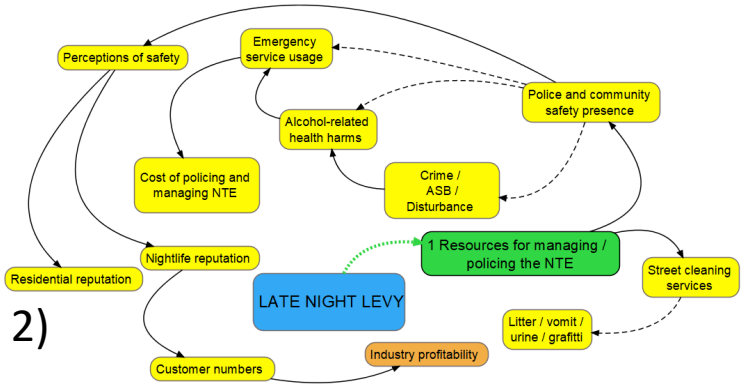
It is a possibility that nearly 40 licensed premises in the [local area] BID area will not vote for the BID again if this means that they pay two levies instead of only one. A BID needs a majority by numbers and also rateable value to succeed. A failure to achieve either one of these would therefore, jeopardise the provision the BID makes for policing and cleaning […] (Consultation response, Pub manager)

Theories of change 3 and 4: premises shut early or close entirely



Many operators will have to curtail their hours irrespective of the economic consequences, thereby reducing the number of post-midnight premises in the borough. […] visitors to the Borough's late night economy [would be] choosing other areas of London where no such restrictions apply with obvious economic consequences for [LA]'s late night economy and the businesses that rely on it. (Consultation response, Operator of managed pubs)

Phase 2: Key findings (1): increased resources



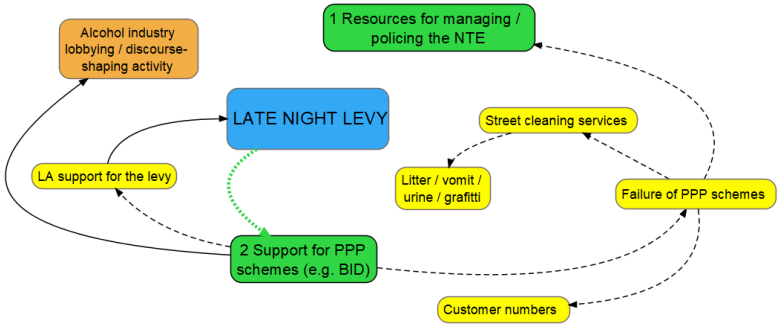
- Revenue raised: £397,279 (Year 1) and £377,122 (Year 2)
- Reductions in alcohol-related crimes compared to previous 12 months: 17% (Year 1) and 21% (Year 2)

- Community safety patrol provided welfare checks and intervened early in anti-social behaviour
- Community safety patrol developed relationships with licensed trade which was used to share information and prompt changes to venue management:

> *One of the things you absolutely have when you're any form of policing, really, you've got to have that consistency. You've got to have the relationships. That comes from, you know, repetition. It's from meeting the DPSs [designated premise supervisors] on a regular basis, building up a trust and an understanding of what you're there to do […]. Well if you're on rotation you can't possibly know.* (Interview, Community safety officer)

> Interviewer: do you think [the LNL] has changed kind of how people consume alcohol in the borough?
> Respondent (Police licensing officer): *I don't think it's changed how people consume their alcohol in the borough. I think it's changed how operators operate.*

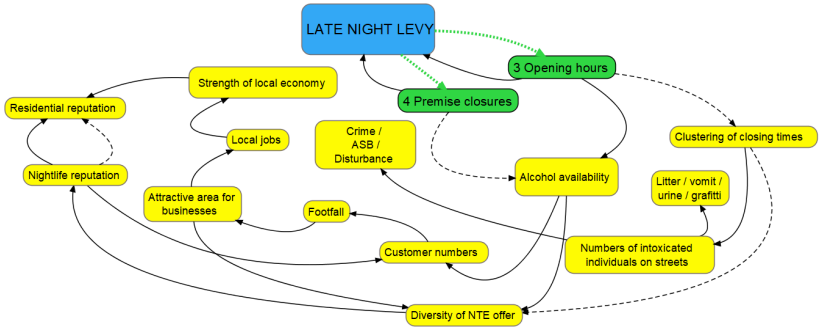
Phase 2: Key findings (2)



- The local Business Improvement District (BID) did not fail, but expanded
- Levy-funded services complemented rather than replaced the BID-funded services

The night time economy is a major contributor to the wealth of the [BID area]. Making sure the environment is fun yet safe is a huge undertaking, not only for us licensees but also for the police and [LA] Council. [BID name] makes sure we are all working together. Not only do we have the [BID-funded] Police Team at our disposal but can also rely on [LNL-funded service]. (BID Annual Report, 2016/17, Bar Owner)

Phase 2: Key findings (3)



- A quarter of all premises varied their hours to avoid the levy
- Some clustered closing times, but no resultant 'defacto terminal hour'
- No obvious reduction in diversity of the night-time economy

[Name] was talking about how there used to be only one place really to go (The Name – which she says is a great pub), but now there are so many options. The places to go out don't just include alcohol: "It used to be that there were just three places to eat ... [she lists their names] and now there are so many to choose from. (Excerpt from fieldnotes)

Value of adding a systems perspective to the LNL evaluation

- Begin with developing an understanding of the system before considering how the intervention may have impacts
- Exploration of multiple pathways through which the levy may have impacts, including some that were unanticipated
- Consider the dynamic system responses to the intervention (i.e. how do hypothesised causal chains play out over time)
- Can locate the findings within broader systems (e.g. national and international systems that include commercial actors and their interactions with government policy making)

Overall reflections

- Use a systems approach to widen the scope of your evaluation
- Be explicit about the approach you're taking and the underpinning theory
- Adaptive nature of the evaluation
- There is room for development and innovation in systems thinking and public health evaluation

NIHR SPHR Systems Guidance

Egan M, McGill E, Penney T, Anderson de Cuevas R, Er V, et al. 2019. NIHR SPHR Guidance on Systems Approaches to Local Public Health Evaluation. Part 1: Introducing Systems Thinking. London: National Institute for Health Research, School for Public Health Research.

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