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Integrating diverse data sets to improve causal inference

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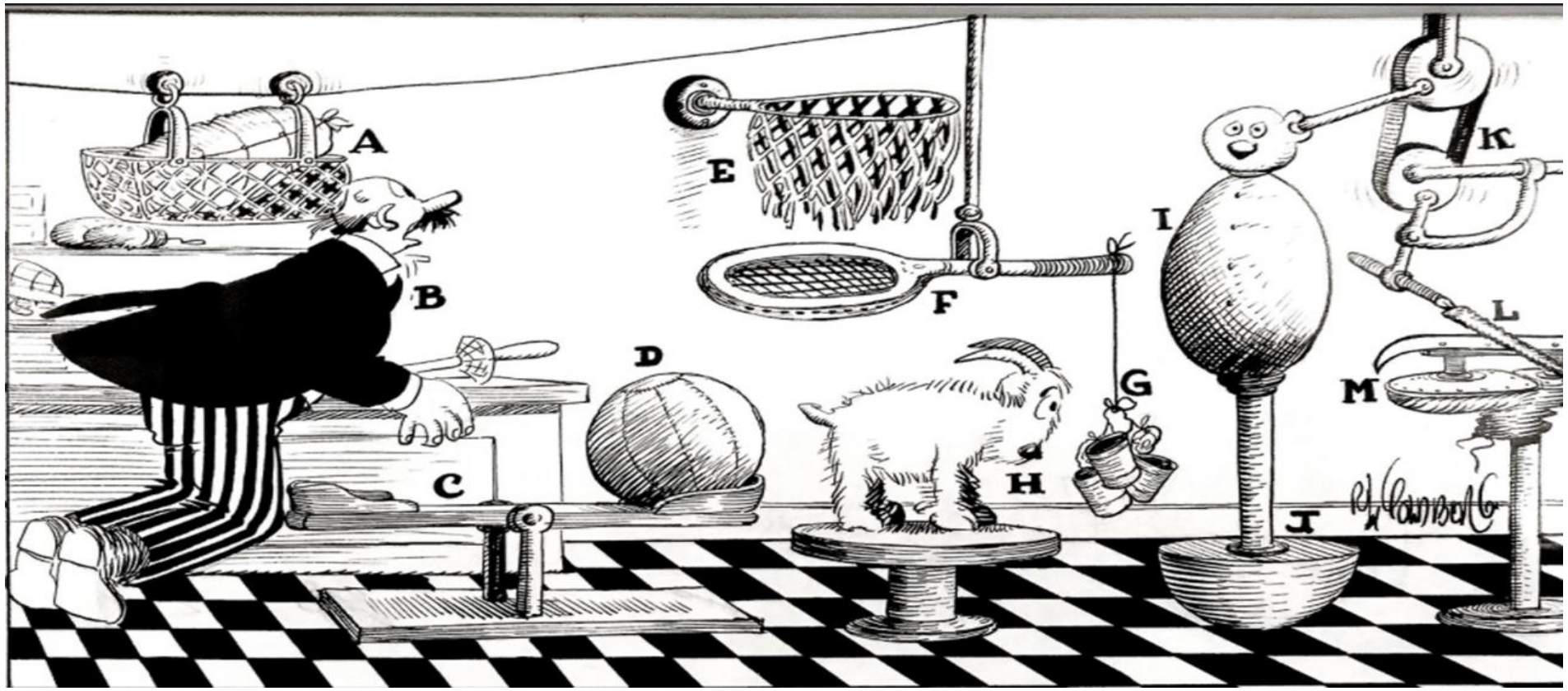
Context

- Most public health evaluations utilise a mix of data derived from different disciplines/sources
- Often, analysis and reporting done ‘in parallel’
- Scope for better exploitation of (integrated) data analysis?
- To provide:
  - More useful (transferable) and robust (credible) evidence
  - Better purchase on causal processes in complex system

Challenge: logics of causal inference differ…

- Quantitative analysis (eg in RCTs or natural experiments): deductive, probabilistic, based on difference between case and counter-factual
- Qualitative analysis – typically derives from some kind of analytic induction (Znaniecki, 1934) whereby arguments are built up through a series of comparisons to derive commonalities, then logically testing (eg grounded theory).

  - Nancy Cartwright (2007)– ‘clinchers’ (but narrow) vs ‘vouchers’

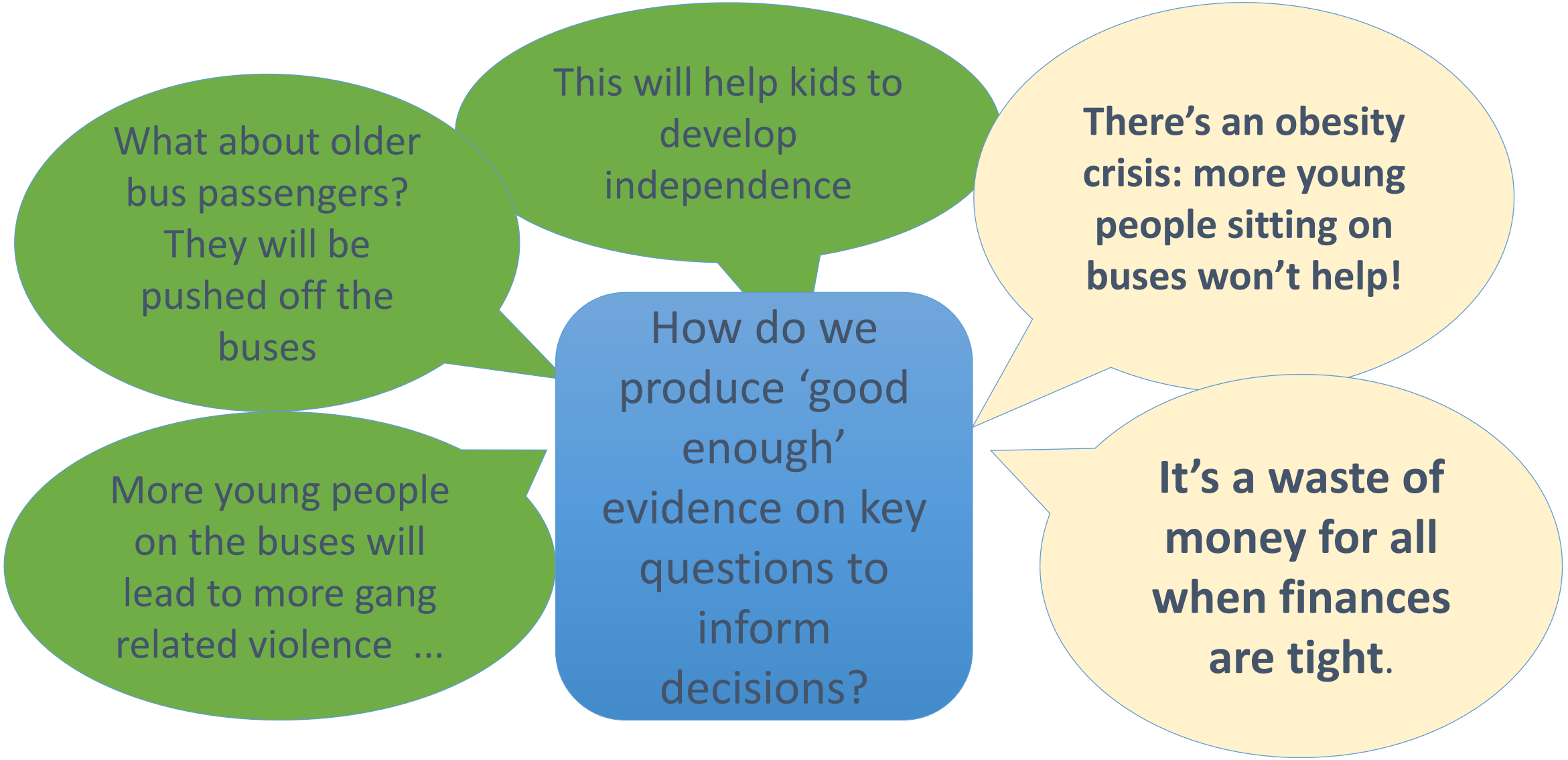


"Different underlying structures yield different causal and probabilistic relations. The problem is we often do not understand these underlying structures nor how they work to give rise to the causal relations an intervention might use." (Cartwright & Munro 2010)

Example: evaluation of public health impacts of free bus travel for young people in London

- Introduced in 2005/6
- Scheme aimed to:

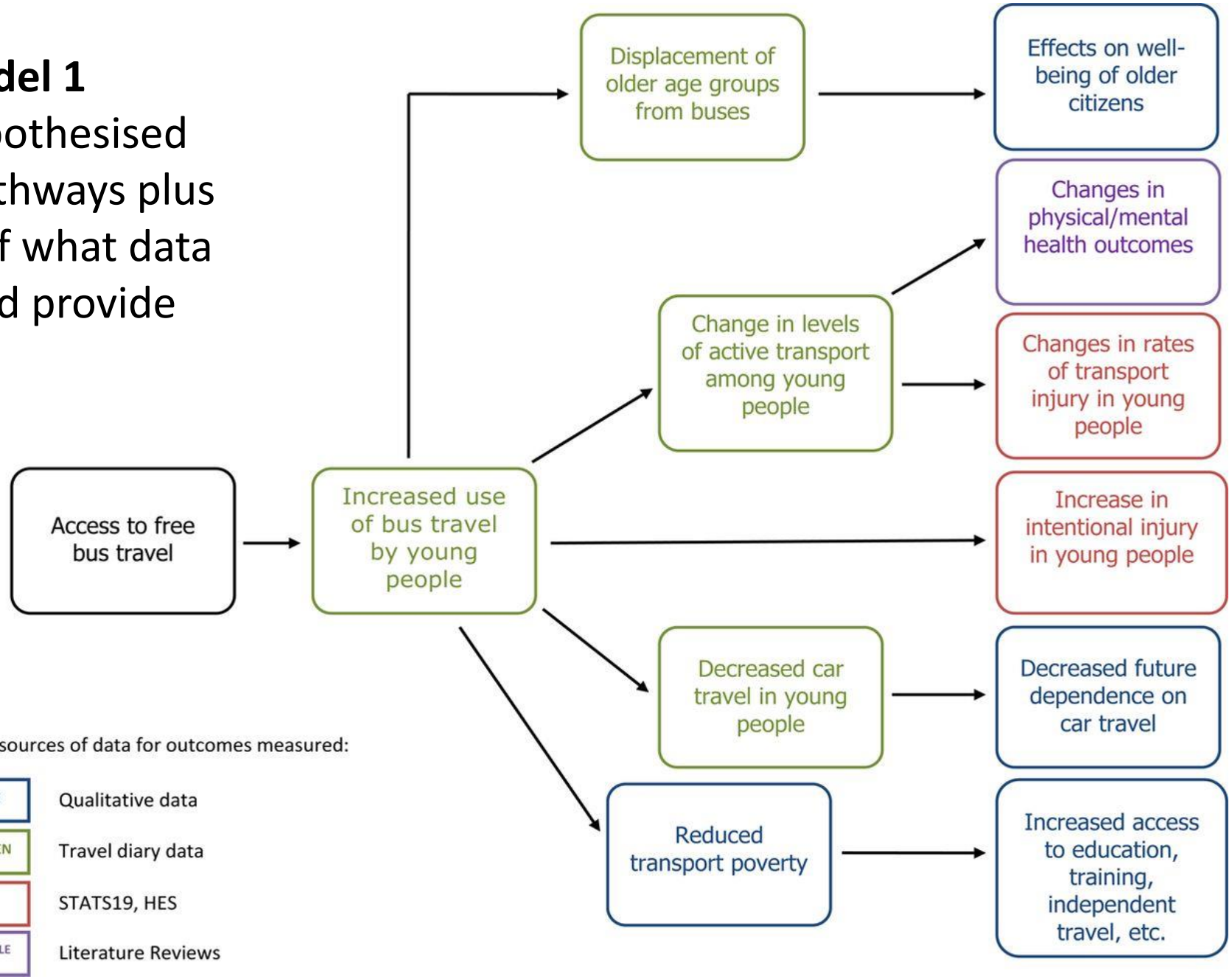
  'help young people to continue studying, improve employment prospects and promote the use of public transport' (Transport for London 2006)
- 'On The Buses' NIHR funded evaluation



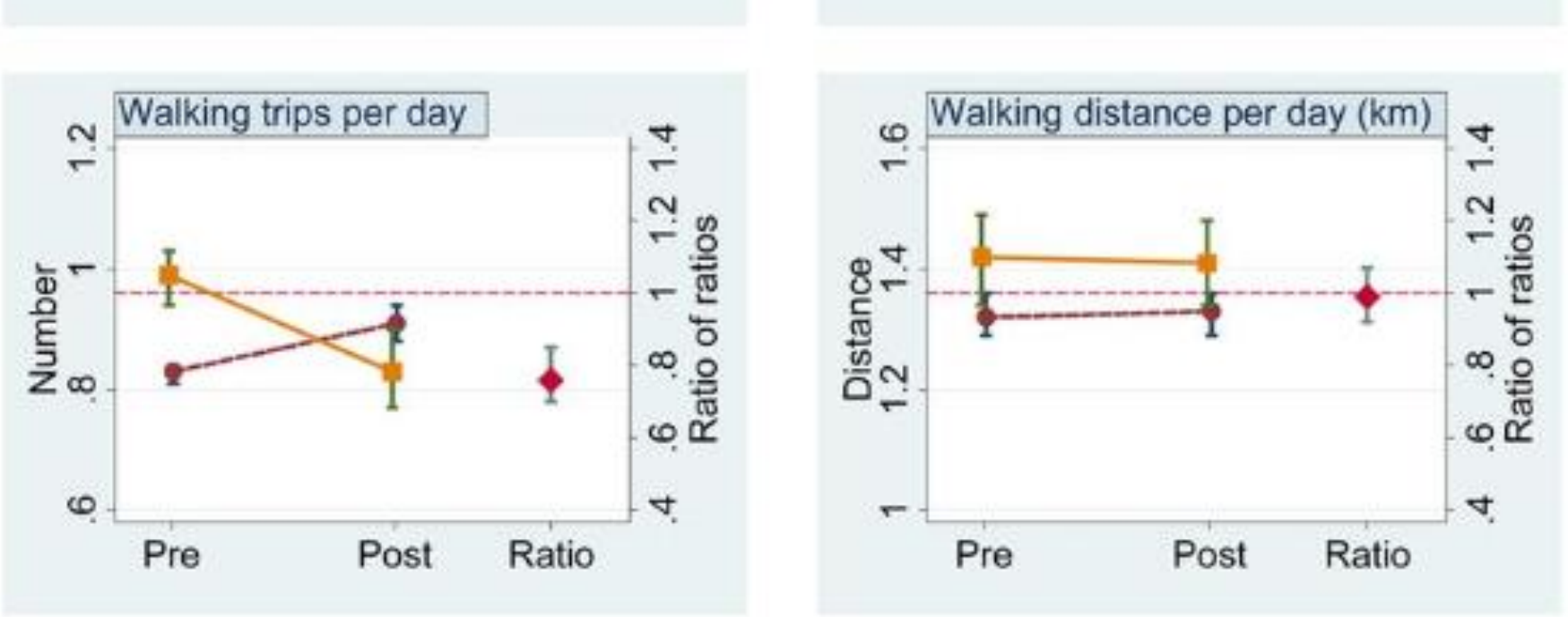
"Decision makers need evidence on the underlying principles by which an intervention works and on the key contextual factors which influence its effect" (Green et al 2015)

Logic Model 1

Initial hypothesised causal pathways plus scoping of what data sets would provide evidence



Walking



Pre–post changes to travel by mode: young people (orange) and adults (red) with ratio of pre–post changes comparing young people with adults. Vertical bars show 95% CIs. Horizontal dotted line indicates ratio=1 (ie, no relative change).
Source: Edwards et al (2013)Health impacts of free bus travel for young people *JECH*

Descriptive thematic analysis

Would be misleading – suggest that free bus travel simply replaces active travel:

> My dad takes me a couple of metres down the road, it's only about 200 metres down the road. And then from then I go and get the bus to school. And then there's only a few metres from where I get off the bus to go to school . . . I'm on the bus for roughly about less than a minute.

One solution to integration: drawing on Cartwright & Munro (2010) on capacities

- '**Mode':** how free bus travel operates to promote social inclusion, active travel
- '**Necessary auxiliaries**': what else is needed for free bus travel to promote social inclusion, active travel?
- '**Destroyers':** what can hinder this capacity?
- 'What **other capacities** promote and retard' intervention
- '**Rule of combination**': effect of multiple capacities in a system

More inductive qualitative analysis

- Key driver of YP travel mode choices: traveling together (Goodman et al 2014)
  - So some reduction in car travel (at margins)
- (Free) bus pass provides space for sociability, independent travel, adventure IF ALL CAN DO IT
  - (Lack of pass restricts social activity)
  - (YP with disabilities can't travel together; no advantage from scheme)
- Lack of cost important for 'discretionary' travel
- Pass generates ADDITIONAL trips (which include active travel) + bus travel not entirely 'passive' (Jones et al 2012)

The scheme has **capacities** of increasing social inclusion without reducing active travel

- What promotes this?
  - Universal scheme (enable all to travel; removes stigma)
  - Free (not reduced) fares
  - Accessible bus service (doesn't work for those who can't access bus)

Article

Integrating quasi-experimental and inductive designs in evaluation: A case study of the impact of free bus travel on public health

Evaluation
2015, Vol. 21(4) 391–406

DOI: 10.1177/1356389015605205
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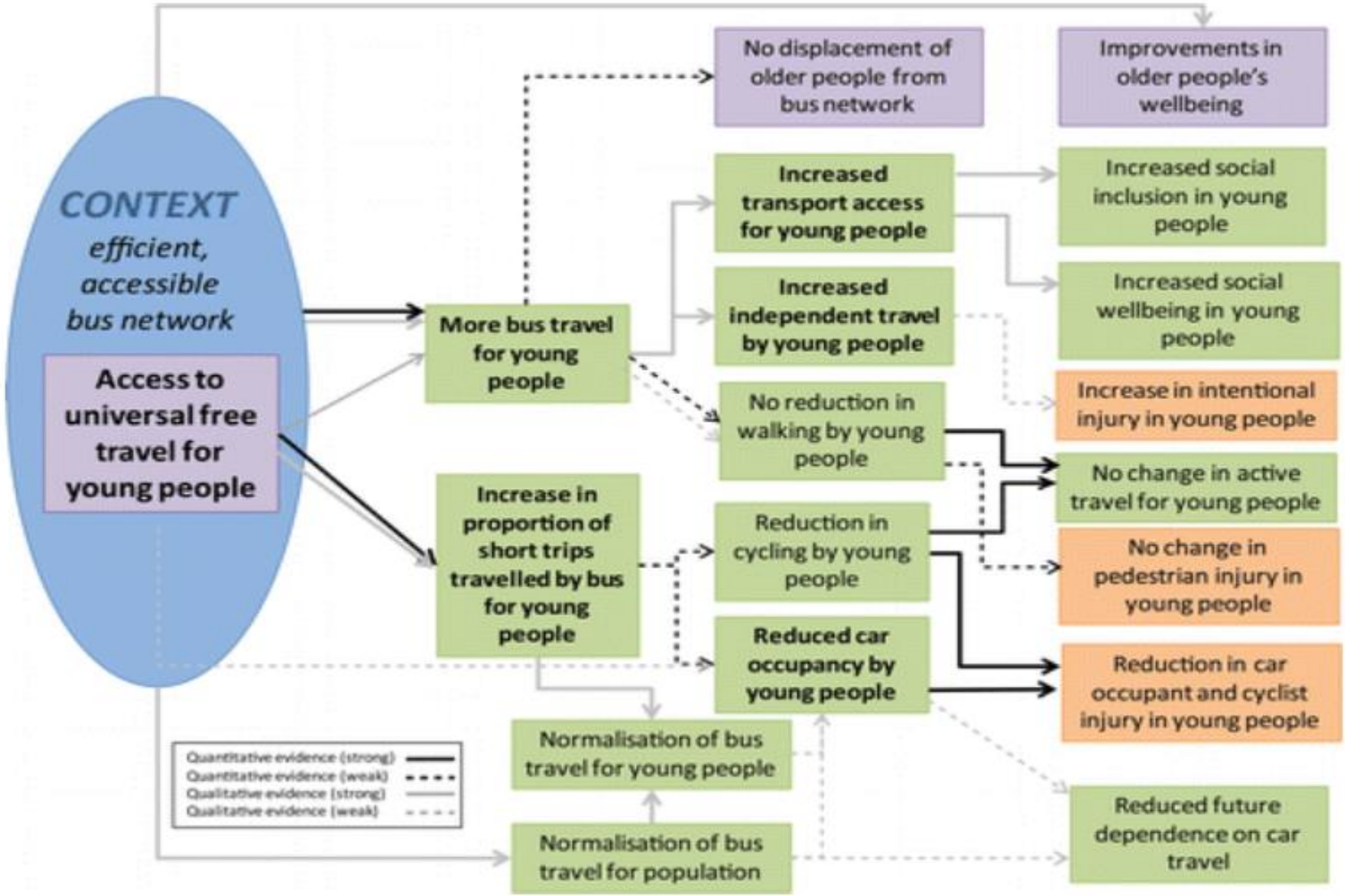

Figure 2. The revised logic model.

Another approach: Qualitative Comparative Analysis

Uses set theory to look at configurations of conditions that lead to outcome/lack of outcome

Value for causal inferences in complex systems is that assumes:

- Equifinality: can identify more than one causal pathway to an outcome
- Conjectural causation: where the presence or absence of conditions in relation to other conditions might be key);
- Causal asymmetry: If factor X explains success, it does not imply that absence of X leads to failure (and vice versa)

Limited use to date: systematic review findings

- Identified 26 studies (all post 2005) using QCA in public health evaluations
- Typical uses:
  - In trials, for process evaluation
  - In systematic reviews, to look at conditions for successful outcomes in interventions/intervention components
  - (less often) comparative implementation/effect of policy interventions
- Although origins of QCA are in comparative policy studies, few uses of this to date in public health literature – more scope?

Source: Hanckel B, Petticrew M, Thomas J and Green J. (forthcoming) The use of Qualitative Comparative Analysis (QCA) to address causality in complex systems: a systematic review of research on public health interventions *BMC Public Health*

Conclusion

- Integration of diverse data sets challenging because analysis often relies on different logics of causality
- Suggest need to be explicit about that: find ways to fold one into other – suggested two ways with promise:
  - Using concept of ‘capacities of interventions’ to think through evidence for different parts (and levels) of causal relations in a system
  - Using QCA to compare ‘configurations of conditions’ that lead to intervention implementation/outcomes across series of cases

Reflections on where integration happens and doesn't

- What has helped?
  - Time - at end of project; meetings; longer term collaborations
  - Equal partnerships: **autonomy** to do the qualitative analysis (recognition of disciplinary expertise)
  - Inductive qualitative analysis
  - 'Boundary objects': logic models
- What hinders?
  - Forcing qualitative components into 'deductive' frames
  - Complex governance (eg ethics more relevant to RCTs)
  - Lack of spaces to publish integrative reports of 'overall' findings

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Acknowledgements

The ‘On the Buses’ study was funded by NIHR PHR, (project number 09/3001/13), and findings from that derives from the work of the project team. The views and opinions expressed are those of the presenter, and do not necessarily reflect those of the Department of Health. The QCA review was funded by MRC: MR/S014632/1 ‘Case study, context and complex interventions (Triple C)’: thanks to Ben Hanckel, PI Sara Shaw, and the wider project team. The funder played no part in the conduct or reporting of the study. JG is supported by a Wellcome Trust Centre grant 203109/Z/16/Z.