Systems Approaches to Obesity Prevention: What does this actually mean?

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Outline

- Pre-systems thinking approaches to obesity prevention
  - G1 Package Testing, G2 Capacity Building
  - Signs of systems change
- Systems thinking and tools
- First at-scale application (G3) – Healthy Together Victoria
  - Promise, progress, demise, lessons, parallel & subsequent approaches
- New Zealand context
  - Healthy Families NZ
  - Regional efforts
  - Indigenous approaches
  - Research programs
- Future directions

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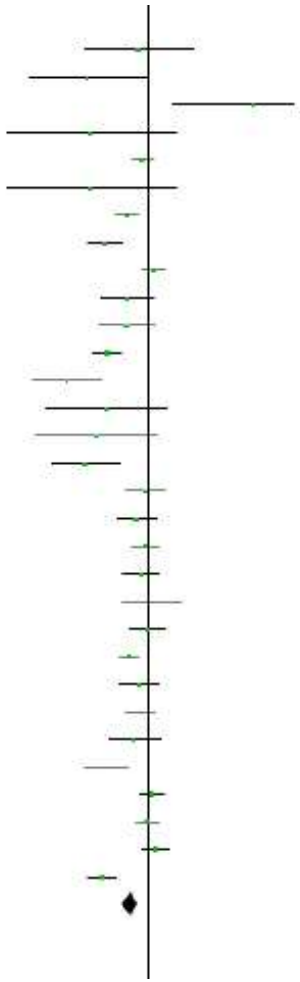
Cochrane meta-analysis - 1º school

1.1.2 6-12 years									
Robinson 2003 (5)	0.5	2.43	28	0.71	2.47	33	1.2%	-0.08 [-0.59, 0.42]	2003
Story 2003a (6)	-0.2	5	26	2	2.41	27	1.0%	-0.56 [-1.11, -0.01]	2003
Baranowski 2003 (7)	3.2	3.53	17	-2.2	6.93	14	0.6%	0.99 [0.23, 1.74]	2003
Beech 2003 (8)	-1.2	6.58	21	2.1	4.85	9	0.6%	-0.52 [-1.32, 0.27]	2003
Caballero 2003	3	2.05	727	3.1	2.05	682	3.3%	-0.05 [-0.15, 0.06]	2003
Beech 2003 (9)	-1.2	6.58	21	2.1	4.85	9	0.6%	-0.52 [-1.32, 0.27]	2003
Kain 2004 (10)	0	1.62	1145	0.3	1.44	491	3.3%	-0.19 [-0.30, -0.09]	2004
James 2004	0.7	0.2	297	0.8	0.3	277	2.9%	-0.39 [-0.56, -0.23]	2004
Kain 2004 (11)	0.3	1.72	996	0.2	1.7	454	3.3%	0.06 [-0.05, 0.17]	2004
Harrison 2006	-0.2	1.3	175	0.1	2	118	2.5%	-0.18 [-0.42, 0.05]	2006
Amaro 2006	0.13	0.68	153	0.26	0.64	88	2.3%	-0.19 [-0.46, 0.07]	2006
Spiegal 2006	0.16	0.89	534	0.52	1.02	479	3.2%	-0.38 [-0.50, -0.25]	2006
Lazaar 2007 (12)	-0.1	0.54	69	0.3	0.52	94	1.9%	-0.75 [-1.07, -0.43]	2007
Lazaar 2007 (13)	-0.1	1.13	30	0.3	0.92	21	1.0%	-0.38 [-0.94, 0.19]	2007
Lazaar 2007 (14)	-0.2	1.4	30	0.4	0.97	21	1.0%	-0.48 [-1.04, 0.09]	2007
Lazaar 2007 (15)	-0.1	0.54	69	0.2	0.49	94	2.0%	-0.58 [-0.90, -0.27]	2007
Paineau 2008 (16)	0.1	1.1	274	0.12	0.91	197	2.8%	-0.02 [-0.20, 0.16]	2008
Gutin 2008	0.1	2.1	182	0.3	1.99	265	2.8%	-0.10 [-0.29, 0.09]	2008
Simon 2008	2.38	2.2	479	2.42	2.14	475	3.2%	-0.02 [-0.15, 0.11]	2008
Vizcaino 2008 (17)	0.2	1.61	231	0.3	1.61	299	2.9%	-0.06 [-0.23, 0.11]	2008
Reed 2008	0.4	2.42	156	0.3	2.92	81	2.3%	0.04 [-0.23, 0.31]	2008
Vizcaino 2008 (18)	0.4	1.64	234	0.4	1.52	280	2.9%	0.00 [-0.17, 0.17]	2008
Sanigorski 2008	-0.09	0.42	833	-0.02	0.39	974	3.4%	-0.17 [-0.27, -0.08]	2008
Paineau 2008 (19)	0.05	0.94	280	0.12	0.91	197	2.8%	-0.08 [-0.26, 0.11]	2008
Foster 2008	1.99	1.9	479	2.1	1.9	364	3.1%	-0.06 [-0.19, 0.08]	2008
Hamelink-Basteen 2008	0.83	1.03	349	0.95	0.73	77	2.4%	-0.12 [-0.37, 0.13]	2008
Taylor 2008	0.8	1.32	201	1.4	1.77	188	2.7%	-0.39 [-0.59, -0.18]	2008
Gentile 2009	0.6	2.9	582	0.5	2.8	619	3.3%	0.04 [-0.08, 0.15]	2009
Donnelly 2009	2	1.9	792	2	1.9	698	3.3%	0.00 [-0.10, 0.10]	2009
Sichieri 2009	0.32	1.43	434	0.22	1.08	493	3.2%	0.08 [-0.05, 0.21]	2009
Marcus 2009 (20)	-0.01	0.73	591	0.3	0.73	430	3.2%	-0.42 [-0.55, -0.30]	2009
Subtotal (95% CI)			**10435**			**8548**	**74.7%**	**-0.15 [-0.23, -0.08]**	

Heterogeneity: $Tau^2 = 0.03$; $Chi^2 = 139.70$, df = 30 ($P < 0.00001$); $I^2 = 79\%$
Test for overall effect: $Z = 4.28$ ($P < 0.0001$)



Most short term
Some successful, some not
Overall reduces BMI
Very few sustained

Waters et al Cochrane Library 2011

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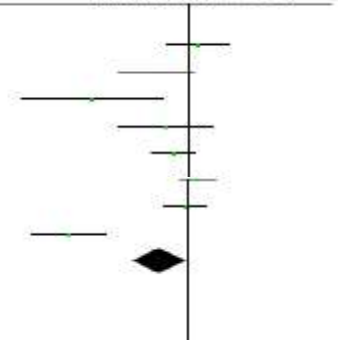
Cochrane 2011 meta-analysis

Pre-school children

Study or Subgroup	Experimental Mean	SD	Total	Control Mean	SD	Total	Weight	Std. Mean Difference IV, Random, 95% CI	Year
1.1.1 0–5 years									
Mo-Suwan 1998 (1)	-0.33	1.23	82	-0.44	1.06	88	2.1%	0.10 [-0.21, 0.40]	1998
Mo-Suwan 1998 (2)	-0.67	0.85	65	-0.39	0.99	57	1.7%	-0.30 [-0.66, 0.05]	1998
Harvey-Berino 2003 (3)	-0.27	0.52	17	0.31	0.7	20	0.7%	-0.91 [-1.59, -0.23]	2003
Dennison 2004	-0.24	1.64	43	0.12	1.75	34	1.3%	-0.21 [-0.66, 0.24]	2004
Fitzgibbon 2005	0.05	0.67	179	0.14	0.68	183	2.7%	-0.13 [-0.34, 0.07]	2005
Reilly 2006	0.07	0.45	231	0.02	0.46	250	2.6%	0.11 [-0.07, 0.29]	2006
Fitzgibbon 2006	0.11	1.54	196	0.13	1.5	187	2.7%	-0.01 [-0.21, 0.19]	2006
Keller 2009 (4)	-0.15	0.23	49	0.11	0.23	134	1.8%	-1.13 [-1.47, -0.78]	2009
Subtotal (95% CI)			**862**			**953**	**15.9%**	**-0.26 [-0.53, 0.00]**	

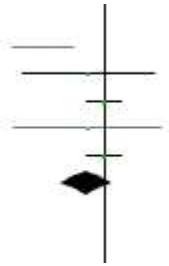
Heterogeneity: $Tau^2 = 0.12$; $Chi^2 = 47.90$, df = 7 ($P < 0.00001$); $I^2 = 85\%$
Test for overall effect: Z = 1.94 (P = 0.05)



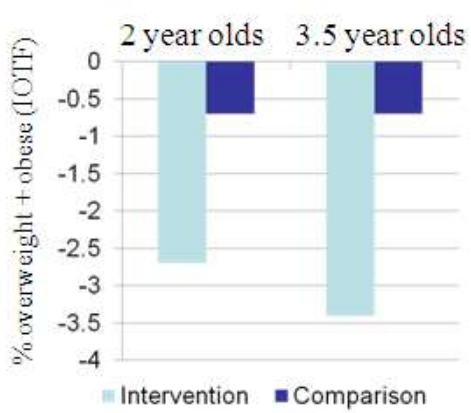
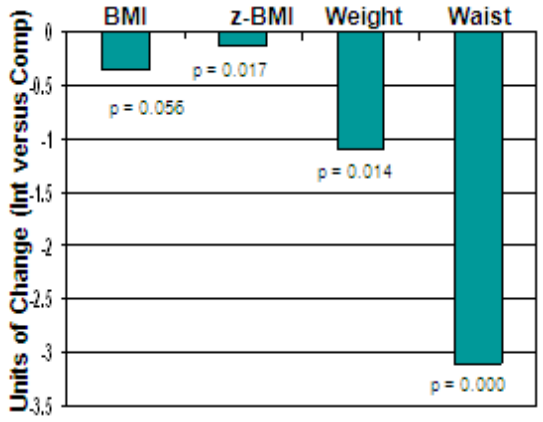
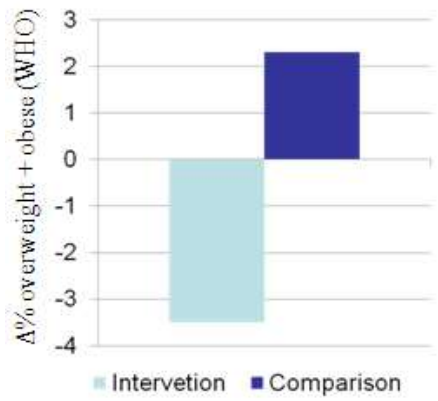
Adolescents

1.1.3 13–18 years									
NeumarkSztainer 2003 (21)	-0.96	3.22	84	0.75	2.59	106	2.1%	-0.59 [-0.88, -0.30]	2003
Williamson 2006	0.73	2.8	18	1.2	3.05	22	0.9%	-0.16 [-0.78, 0.47]	2006
Singh 2009 (22)	0.5	1.37	312	0.5	1.55	208	2.9%	0.00 [-0.18, 0.18]	2009
Peralta 2009 (23)	0.3	1.86	16	0.6	1.83	16	0.7%	-0.16 [-0.85, 0.54]	2009
Singh 2009 (24)	0.4	1.22	276	0.4	1.3	234	2.9%	0.00 [-0.17, 0.17]	2009
Subtotal (95% CI)			**706**			**586**	**9.4%**	**-0.17 [-0.41, 0.08]**	

Heterogeneity: $Tau^2 = 0.05$; $Chi^2 = 13.35$, df = 4 (P = 0.010); $I^2 = 70\%$
Test for overall effect: Z = 1.33 (P = 0.18)



Waters et al Cochrane Library 2011

(Geelong) <5s 2004-'08	↓ 1.8% (2y/o) & 2.7 %(3.5y/o) over 3 y $100k for 12,000 children Δ behaviours and environments Δ state prevalence (de Silva-Sanigorski Am J Clin Nutr 2010)	
(Colac) 4-12y 2002-'06	↓~1kg, 3cm waist over 3y Greater effect in lower SES children No Δ 'safety measures' Sustained & ?spreading influence (Sanigorski et al Int J Obesity 2008)	
(E Geelong) 13-18y 2004-'08	↓5.8 % prevalence over 3 y Δ community capacity Δ in school environments No Δ behaviours (Millar et al Obes Rev 2011)	

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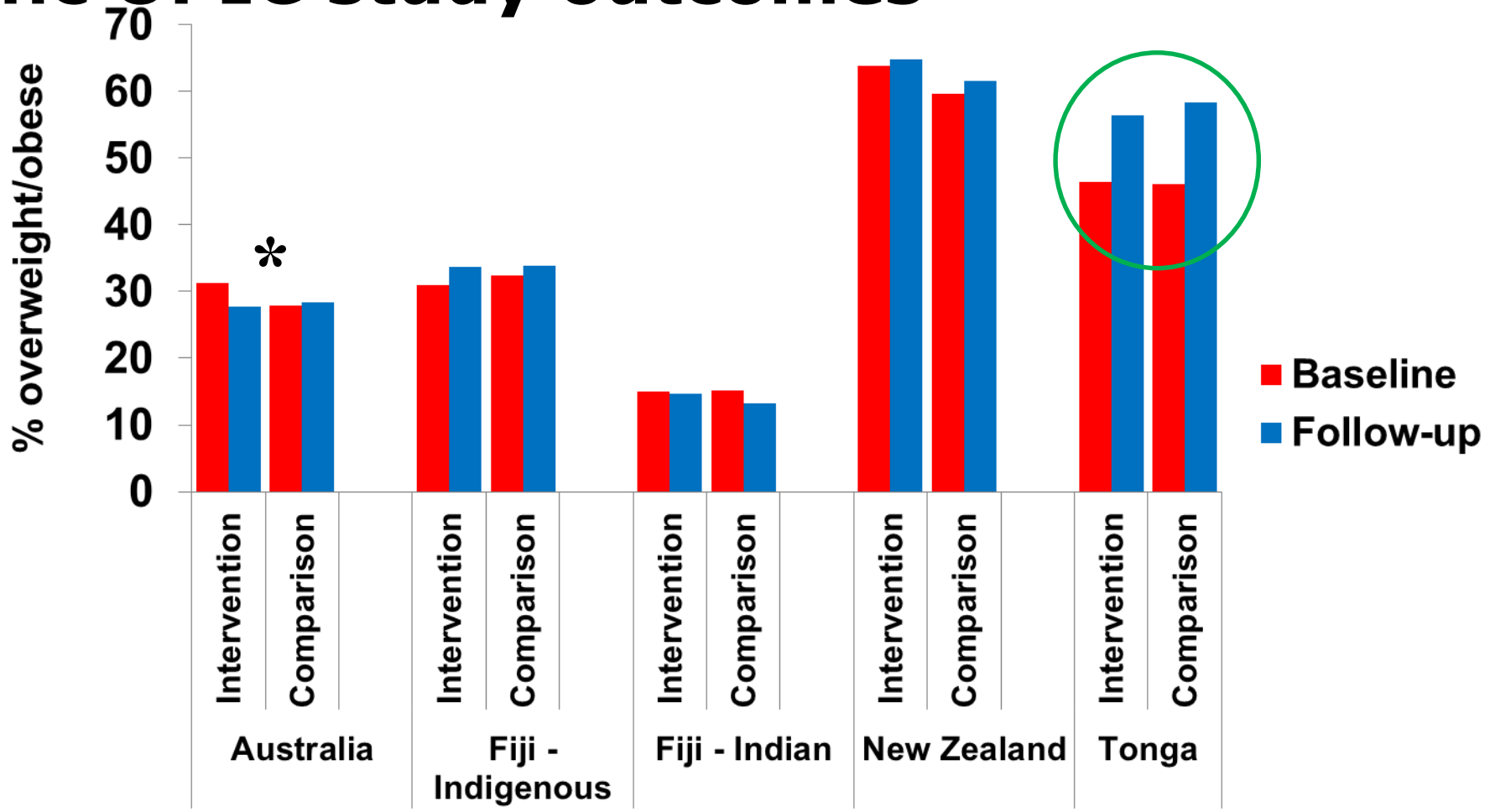
Pacific OPIC study outcomes



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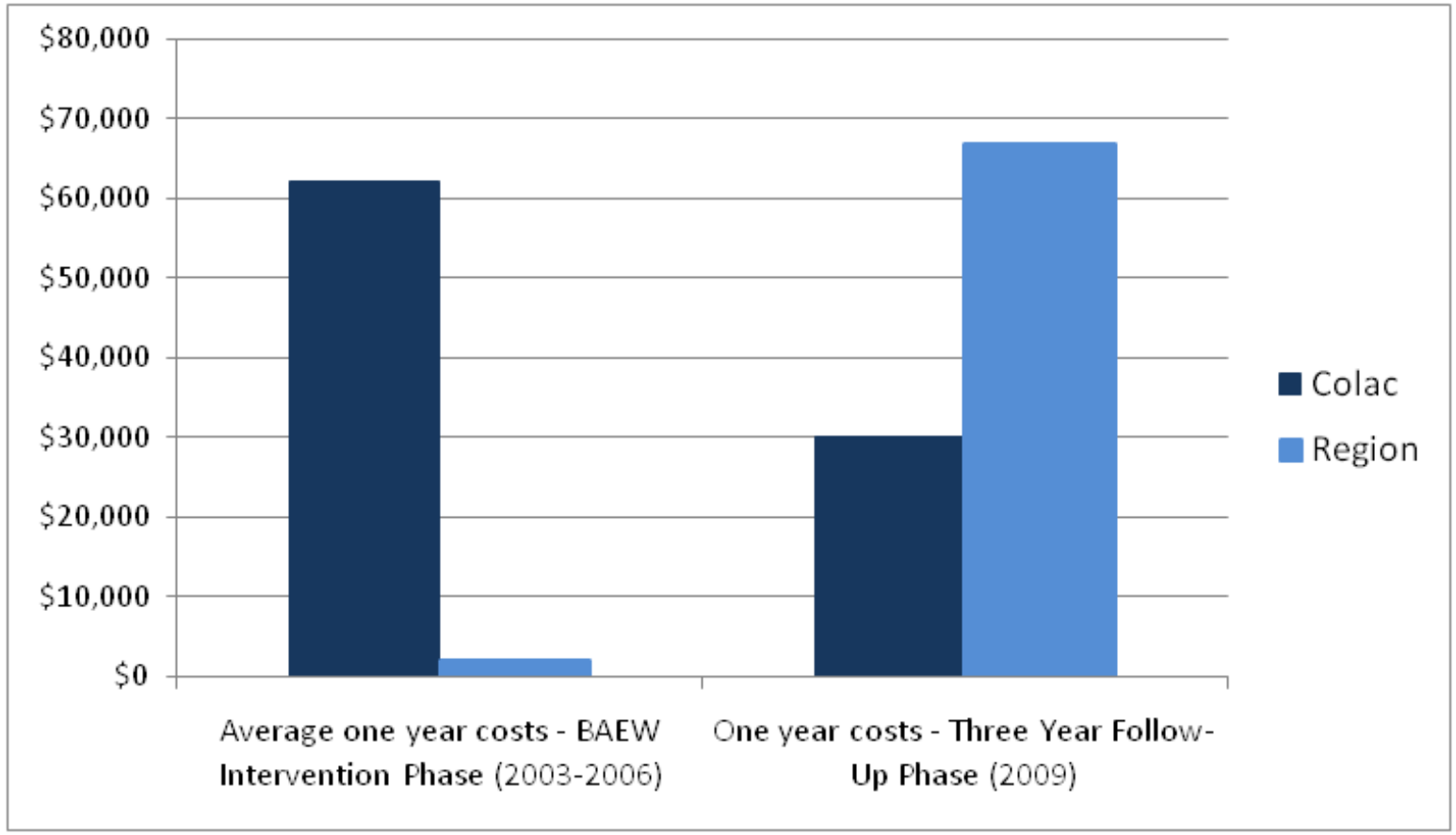
Investment during & after a 3y intervention program in Colac (vs comparison region)



Swinburn et al Ped Obesity 2014

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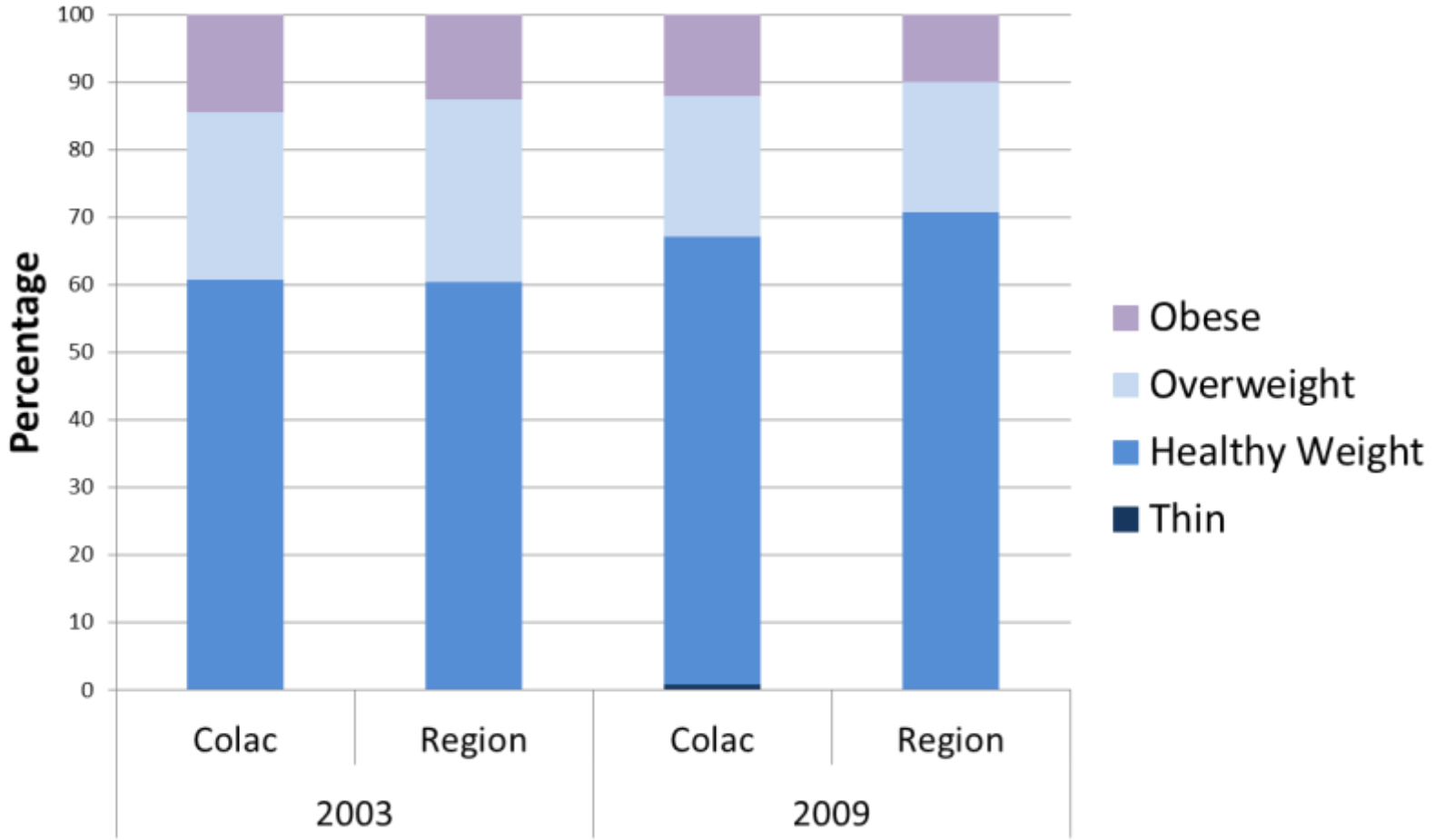
Changes in overweight & obesity prevalence



Swinburn et al Ped Obesity 2014

Other Australian community-based interventions

- 'Scale-up' to 5 communities
  - Bogged down in individual contracting procedures by Vic govt
  - Little scope for local ownership and innovation
  - Shorter time-scale and not effective in reducing obesity
- Metropolitan, multi-cultural intervention
  - Added complexities
  - Relatively ineffective in reducing obesity

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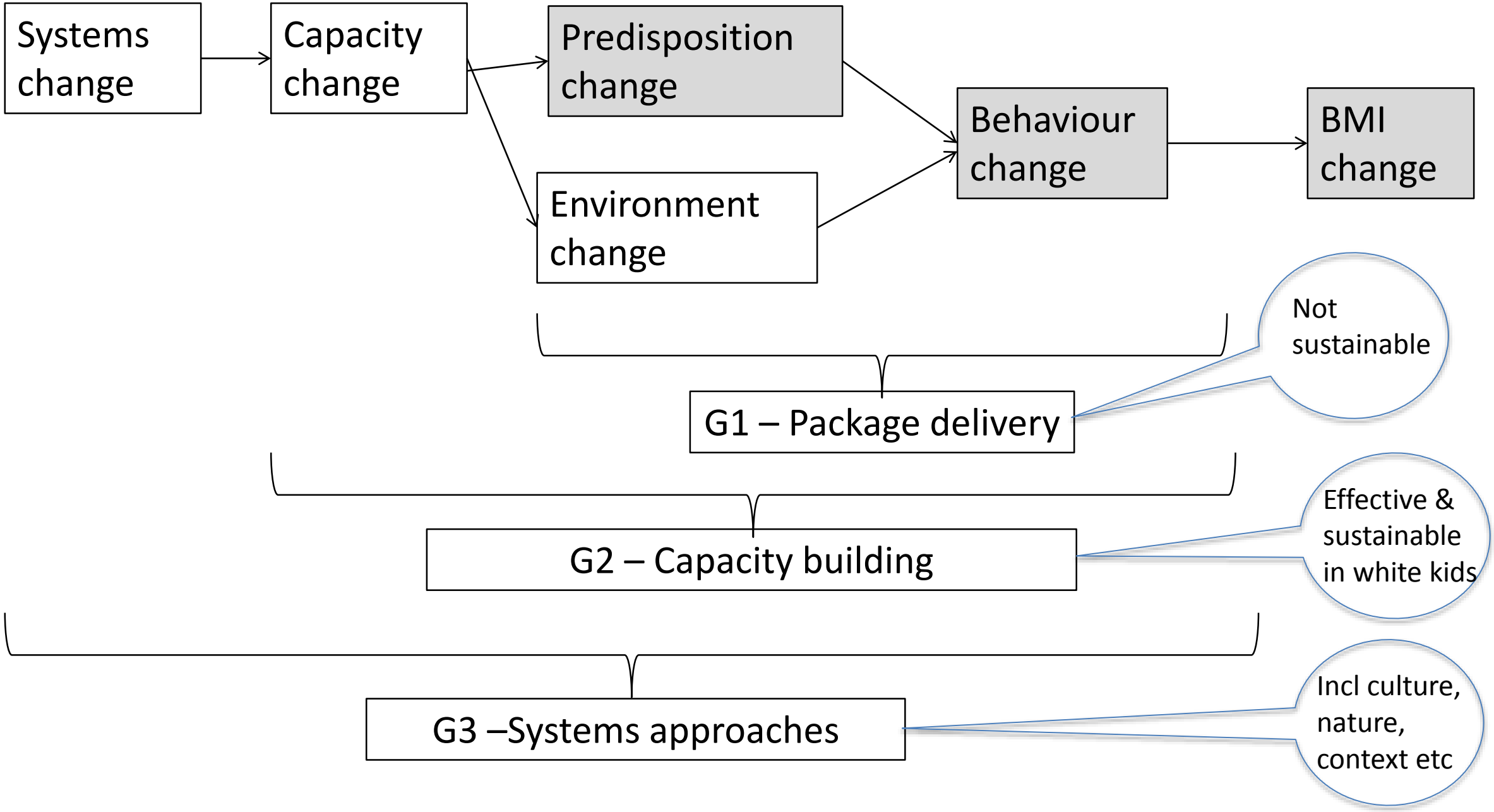
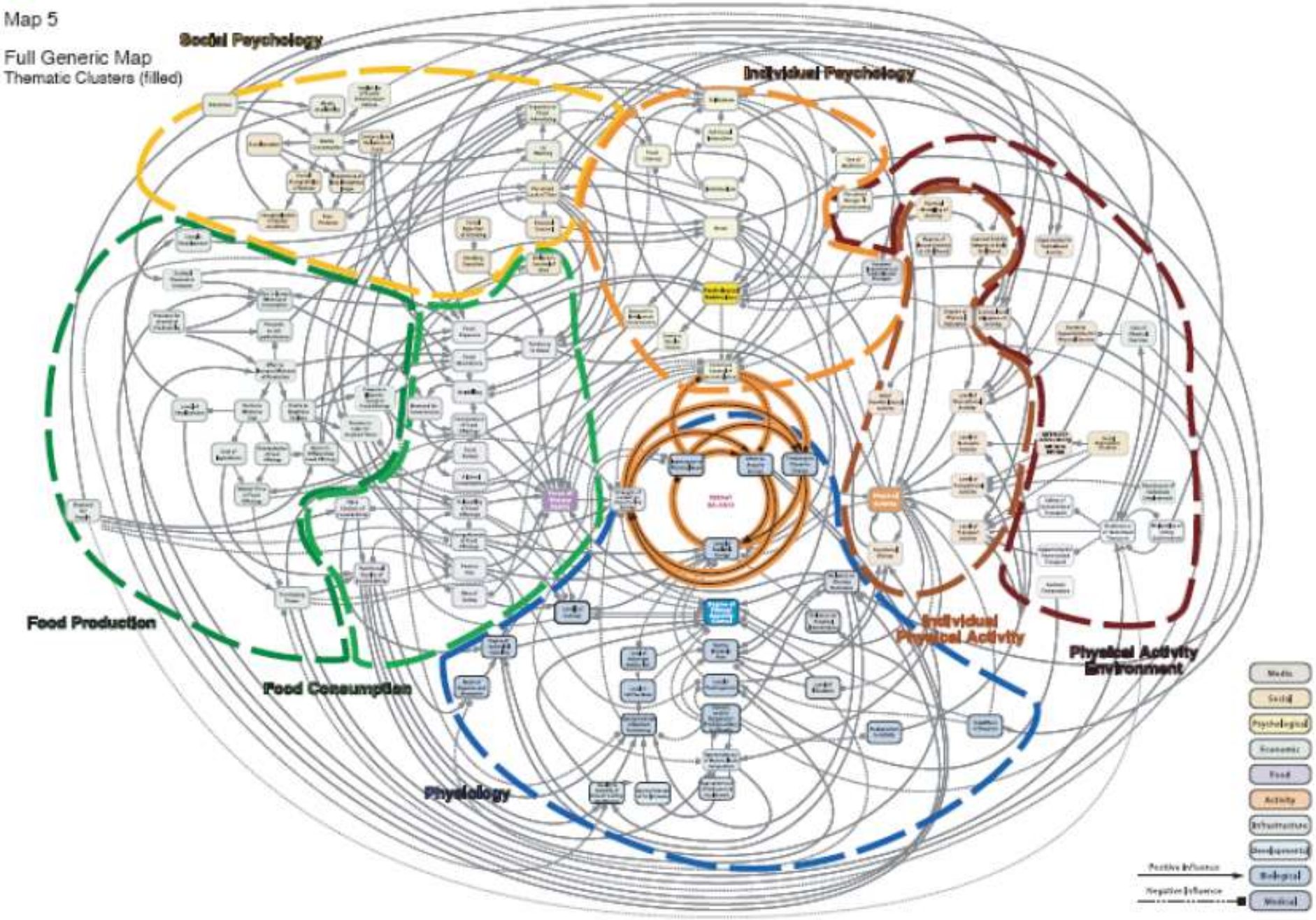
Pre-systems thinking approaches

- Interventions were systems building blocks
- Organisational argy-bargy: ?important sign of systems change
- Quasi-experimental designs & standard epi tools were used
- Low cost interventions eg policies, training
- 'Obesity prevention virus' spreading along networks
- Limitations
  - Not sufficiently effective in non-white communities (indigenous & migrant)
  - Not culturally-centred
  - Govt-managed 'scale-up' inadequate
- Systems: ?at-scale, aligned with cultural perspectives, sustainable


Systems change
Capacity change
Predisposition change
Environment change
Behaviour change
BMI change
Not sustainable
G1 – Package delivery
Effective & sustainable in white kids
G2 – Capacity building
Incl culture, nature, context etc
G3 –Systems approaches

Map 5

Full Generic Map
Thematic Clusters (filled)



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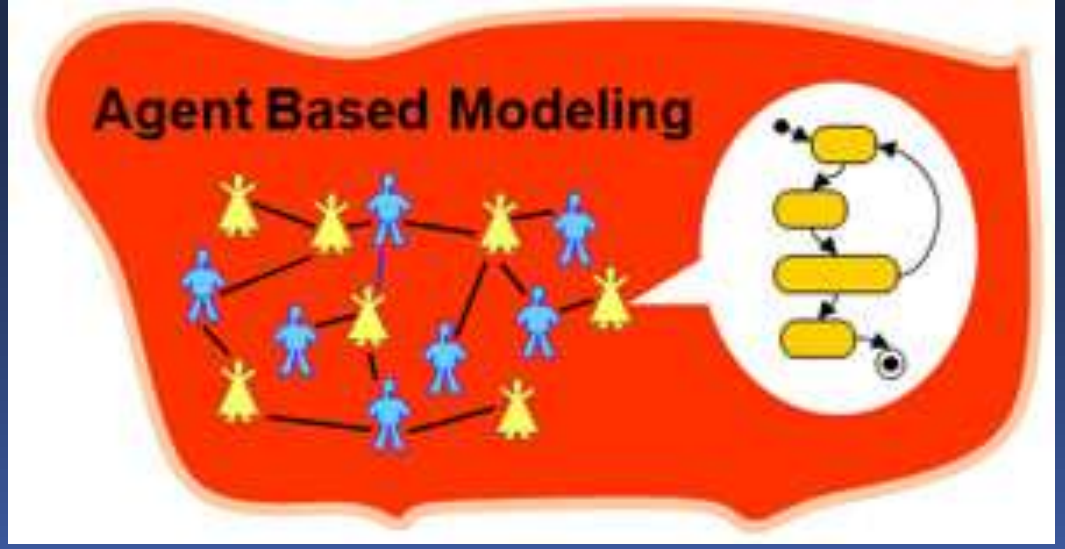
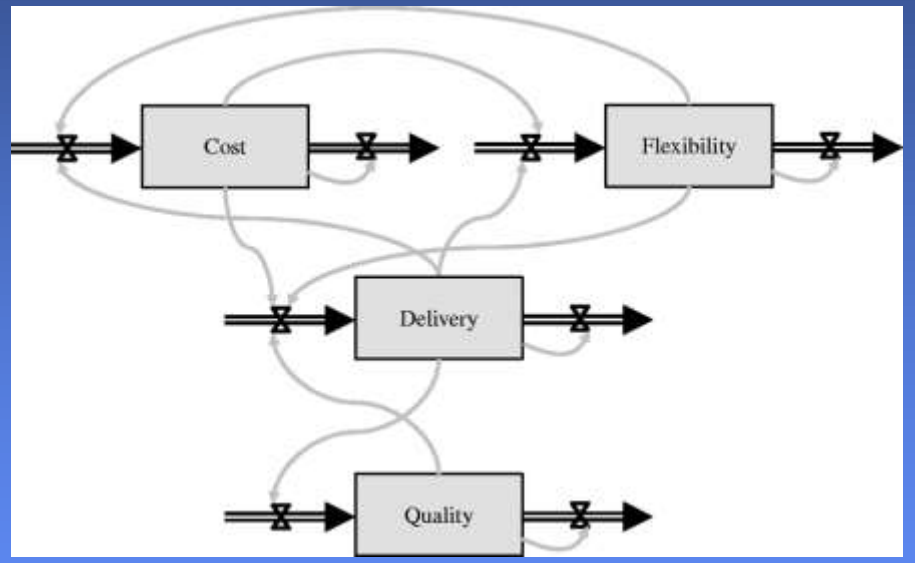
What does a systems approach mean?

- Considering the whole as well as the parts
- Connections, networks, interdependence
- Rules and boundaries
- Dynamics:
  - Feedback loops, delays, non-linear effects, tipping points
- Complexity, adaptability, self-organising
- Patterns and emergence


www.azaphotography.blogspot.com

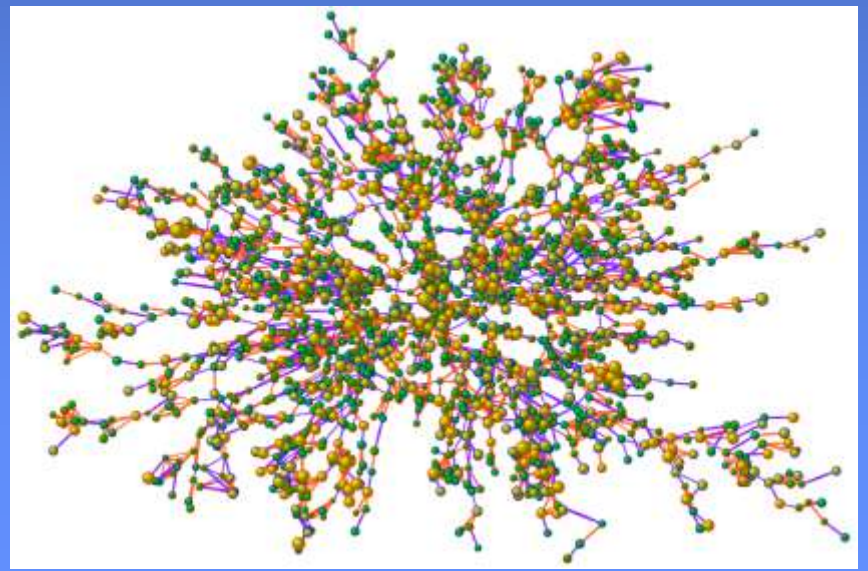
Agent-based Modeling
“bottom up”
Actors & rules



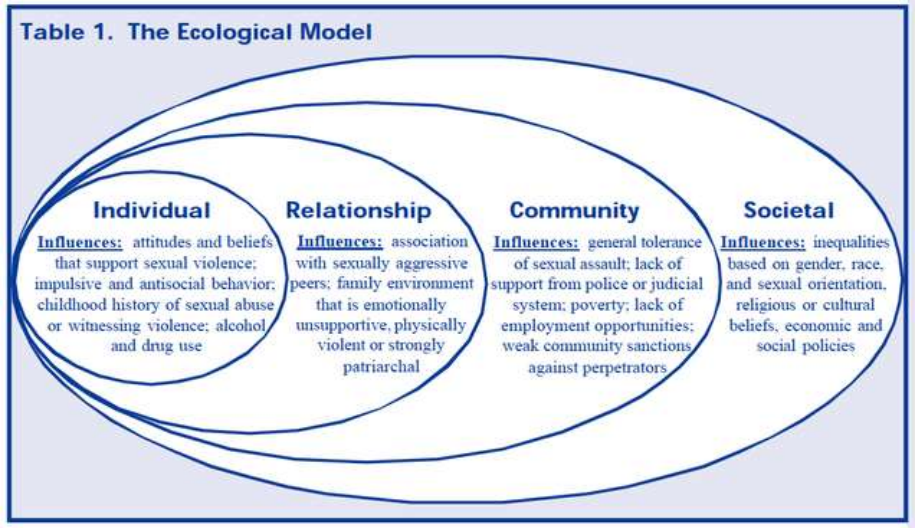


System Dynamics
“top down”
Stocks & flows

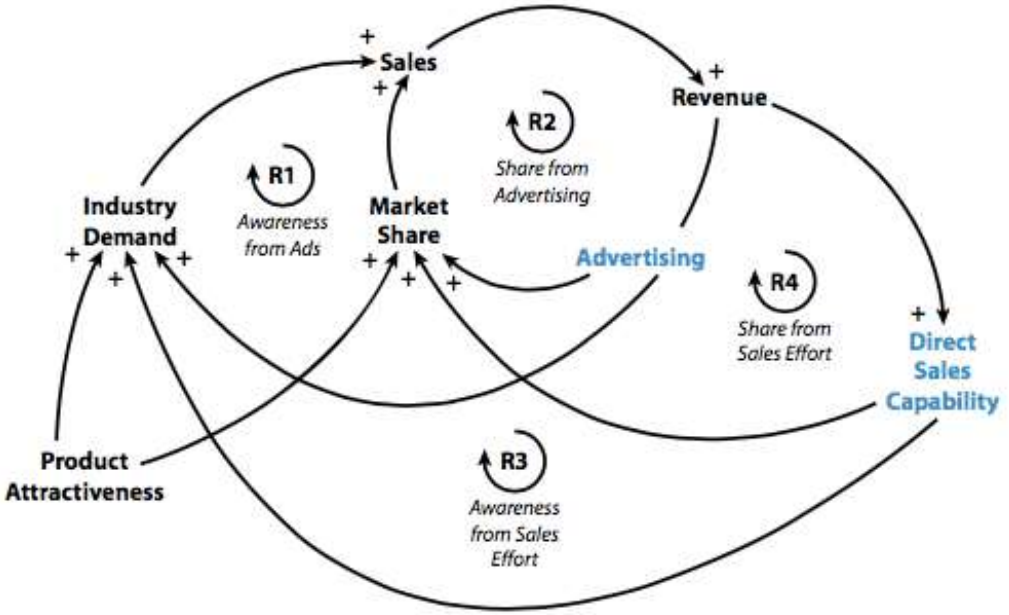
Network Analysis
Nodes &
ties among them



Adding the dynamics



Ecological model



Causal loop diagram

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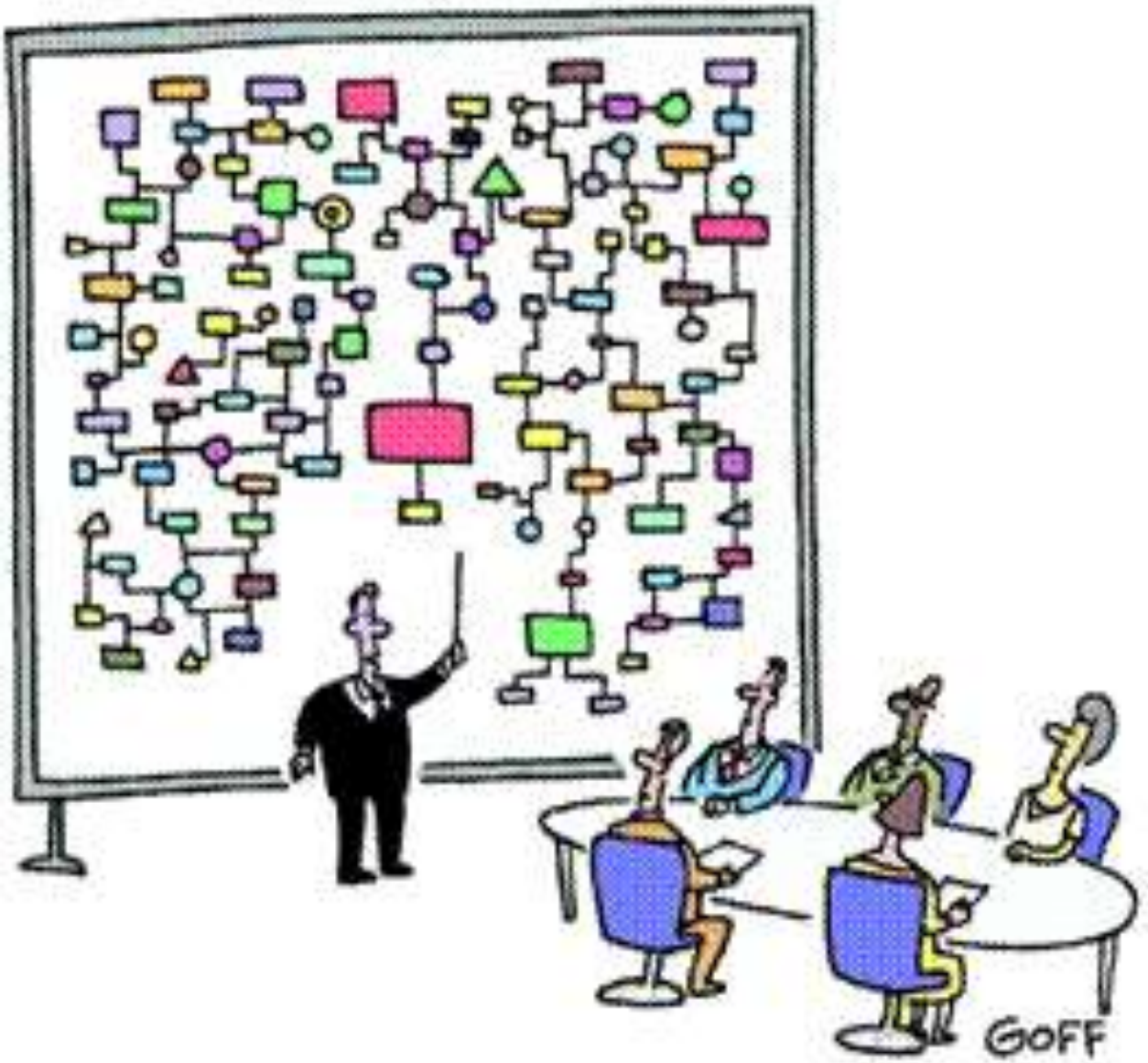

"And that's why we need a computer."

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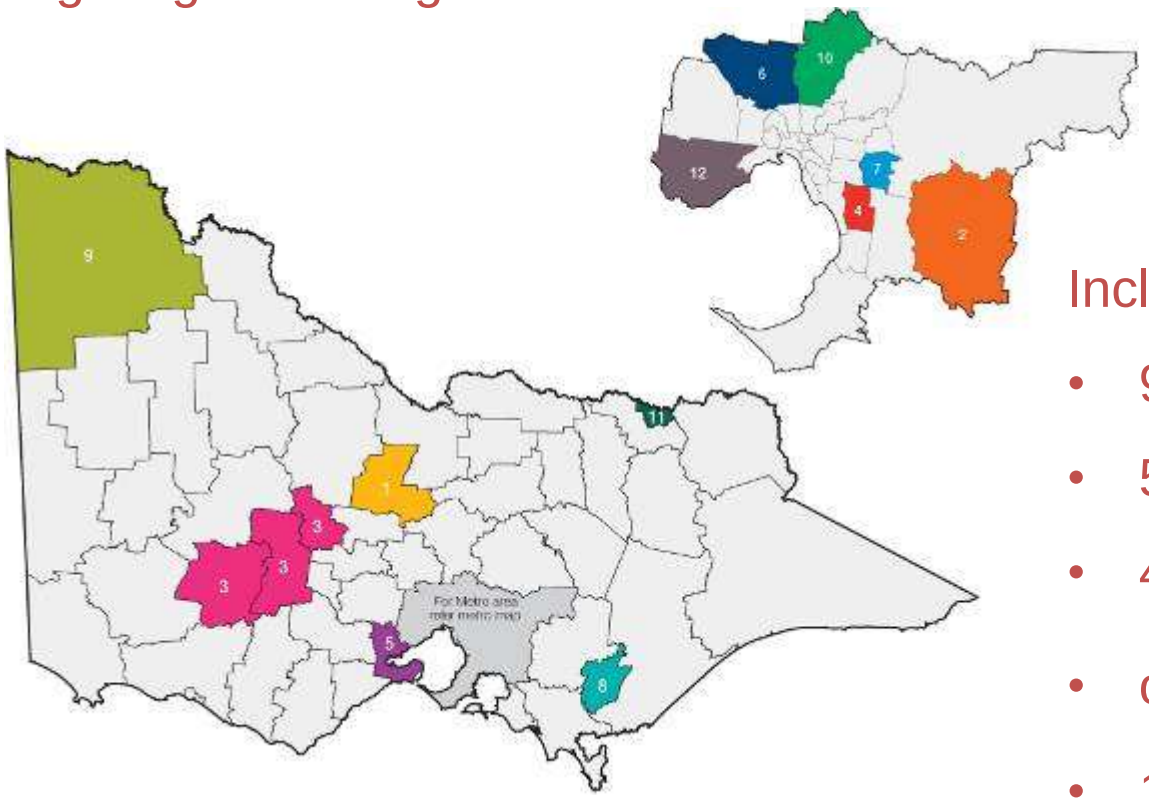
What does it mean for evaluation?

- Intervention characteristics:
  - Complex, at-scale, adaptable, evolutionary
  - Designed and implemented locally
  - Heterogeneous in type and dose
- Evaluation design
  - Null hypothesis testing may not be possible
  - Explaining heterogeneity may be better
  - Answering ‘how’ questions
  - Monitoring vs surveys
- Use of system tools

Healthy Together Victoria

Comprehensive health promotion initiative targeting 14 local government areas



Including:

- 938 early childhood centres
- 520 schools
- 4,409 workplaces and
- over 1.3 million Victorians
- 150 new positions in LGAs

A systems approach to chronic disease prevention

Healthy Together Victoria

- Investment in a systems-based approach through local government
- Injection of capacity into 12 sites (~120 FTE)
- 2 years planning, 3 years intervention, change in govt, prevention defunded
- ‘Prevention virus’ spreading after 3 years
- Non-HTV sites stimulated by HTV activity started their own action
- Little engagement with primary care
- Weak evaluation
- Communities now getting activated

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SYSTEMS SCIENCE: APPROACHES AND TOOLS

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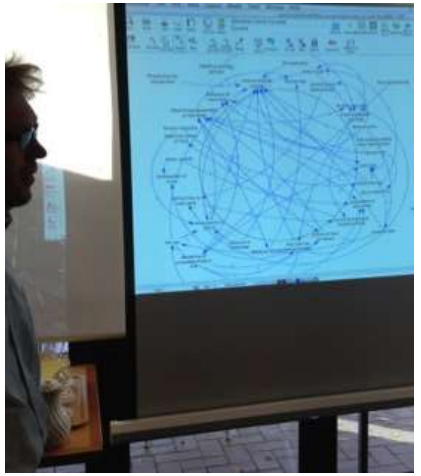
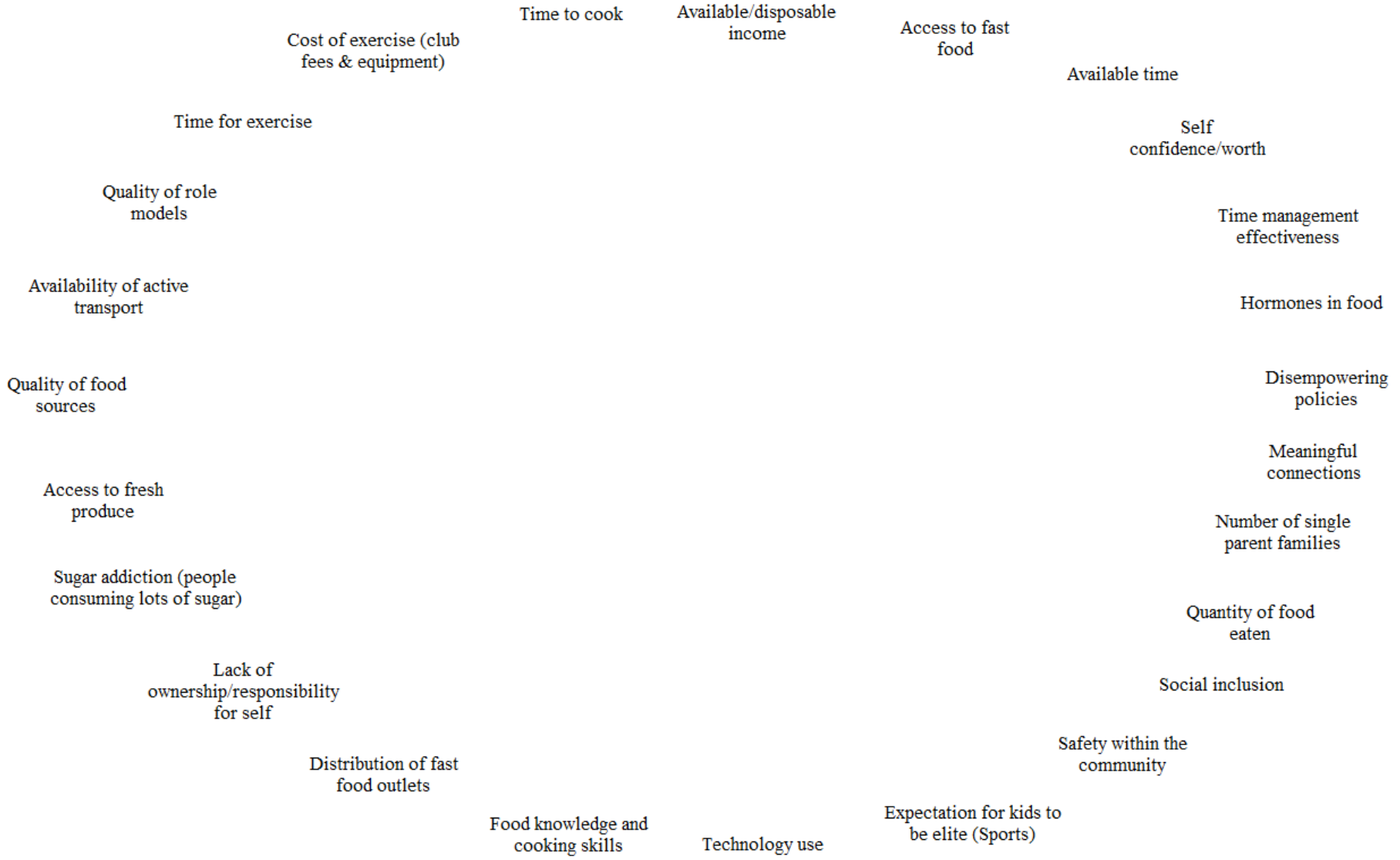
Group Model Building

- Uses system dynamics to develop a causal map/diagram
- Community driven participatory research—core modeling team
- Start with 'Changes over time' with 'Hopes and fears'



Example: Portland Victoria



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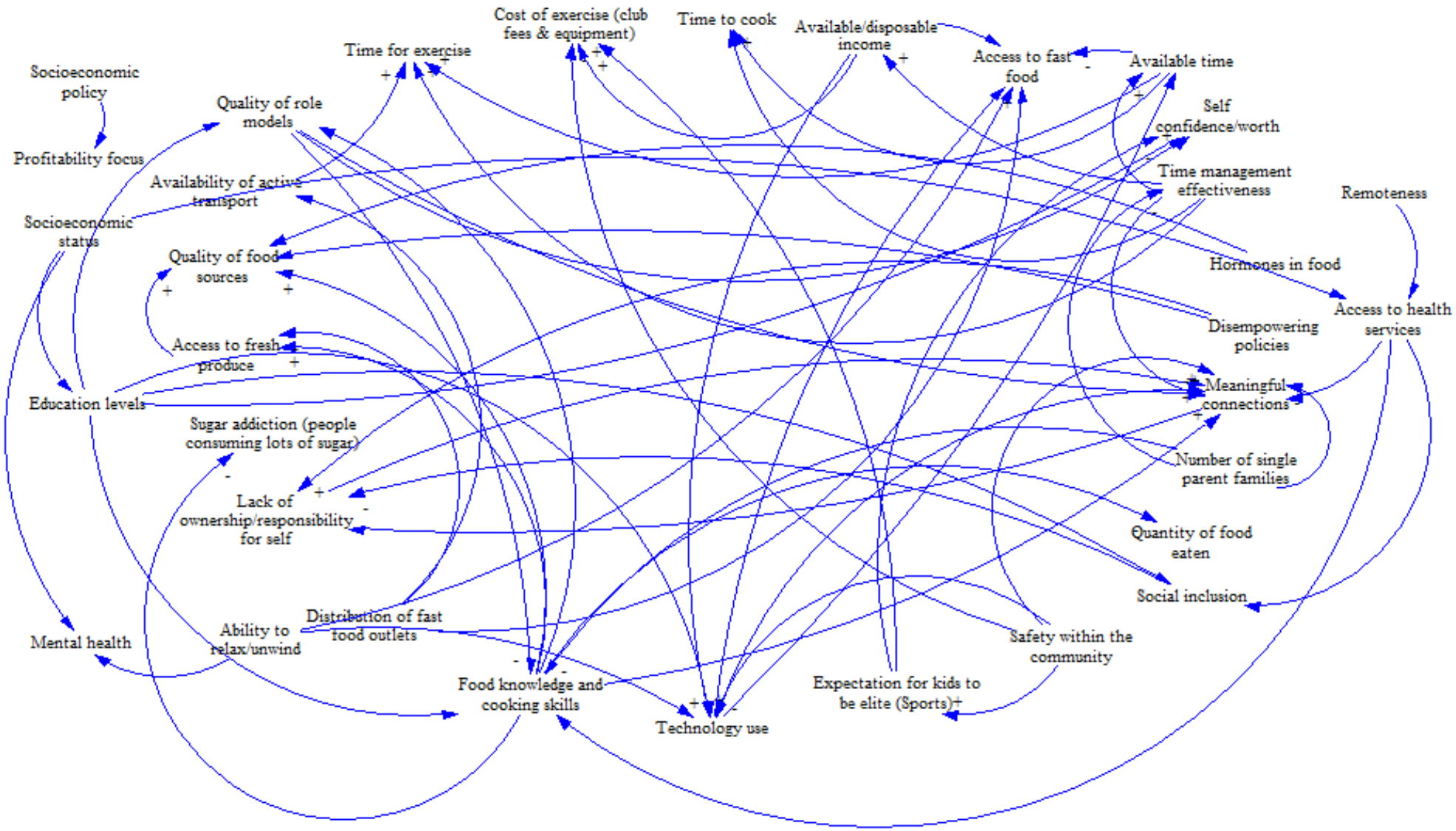

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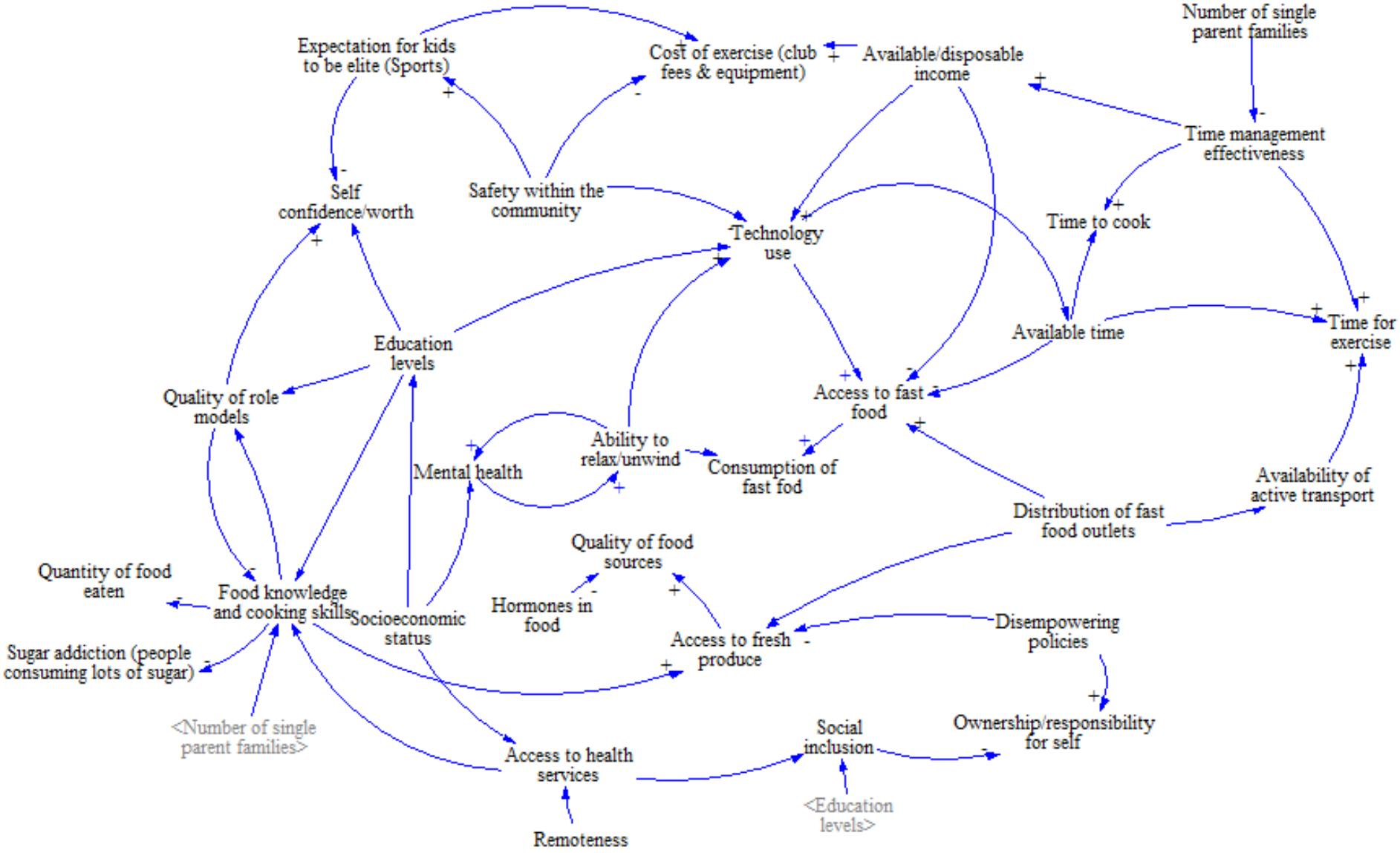
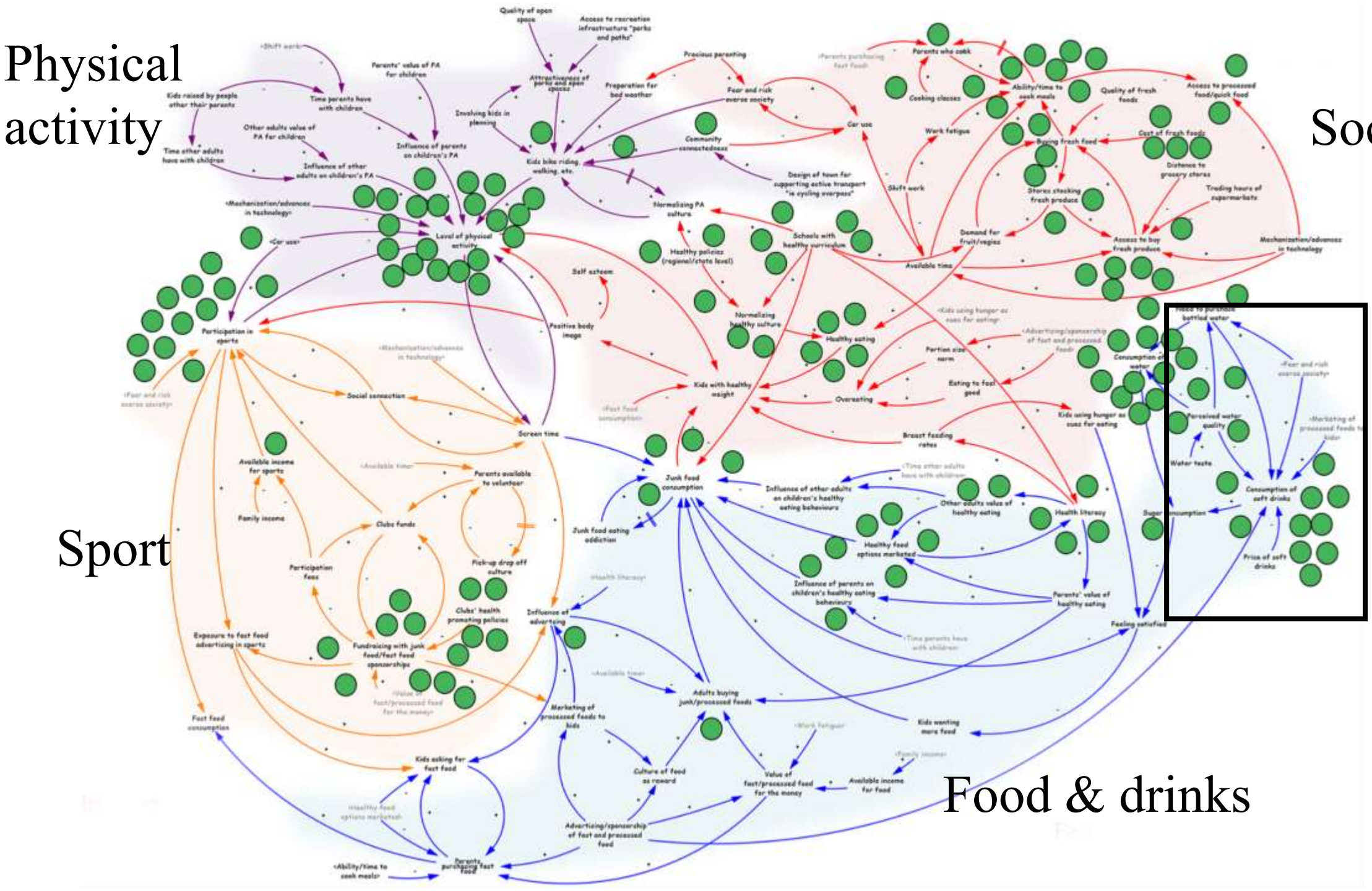
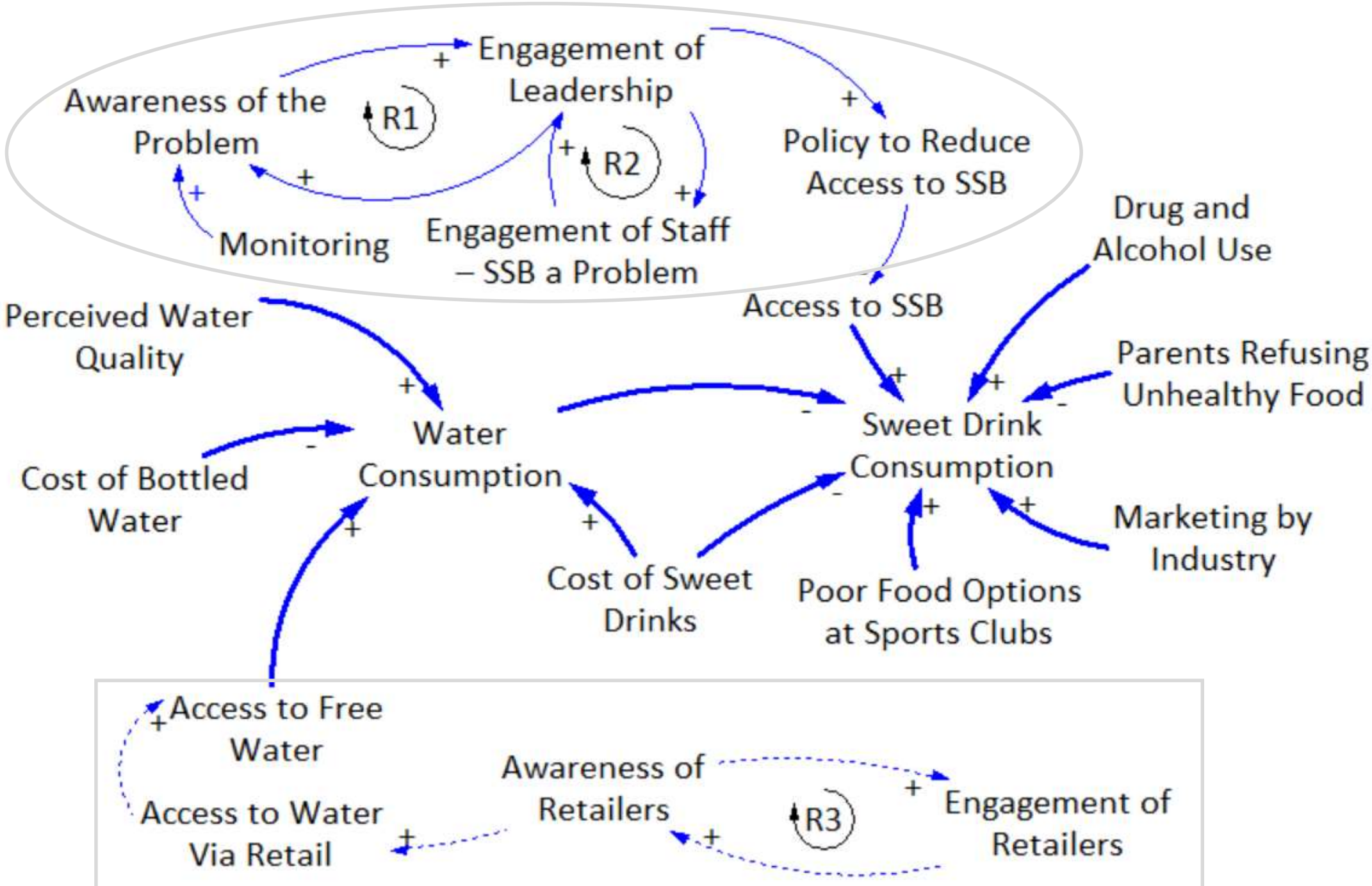



Physical activity
Social
Sport
Food & drinks
Quality of open space
Access to recreation infrastructure "parks and paths"
Attractiveness of parks and open spaces
Parents' value of PA for children
Kids raised by people other their parents
Time parents have with children
Other adults value of PA for children
Time other adults have with children
Influence of parents on children's PA
Influence of other adults on children's PA
Involving kids in planning
Kids bike riding, walking, etc.
Preparation for bad weather
Precious parenting
Fear and risk averse society
Community connectedness
Car use
Design of town for supporting active transport "ie cycling overpass"
Normalising PA culture
Level of physical activity
Mechanization/advances in technology
Car use
Participation in sports
Self esteem
Positive body image
Healthy policies (regional/state level)
Schools with healthy curriculum
Normalising healthy culture
Healthy eating
Portion size norm
Overeating
Eating to feel good
Kids with healthy weight
Kids using hunger as cues for eating
Advertising/sponsorship of fast and processed foods
Parents who cook
Cooking classes
Ability/time to cook meals
Quality of fresh foods
Access to processed food/quick food
Work fatigue
Shift work
Buying fresh food
Cost of fresh foods
Distance to grocery stores
Stores stocking fresh produce
Trading hours of supermarkets
Demand for fruit/vegies
Access to buy fresh produce
Mechanization/advances in technology
Available time
Social connection
Screen time
Available income for sports
Family income
Parents available to volunteer
Clubs funds
Participation fees
Pick-up drop off culture
Clubs' health promoting policies
Fundraising with junk food/fast food sponsorships
Exposure to fast food advertising in sports
Fast food consumption
Junk food consumption
Junk food eating addiction
Influence of other adults on children's healthy eating behaviours
Other adults value of healthy eating
Health literacy
Healthy food options marketed
Influence of parents on children's healthy eating behaviours
Parents' value of healthy eating
Influence of advertising
Marketing of processed foods to kids
Adults buying junk/processed foods
Kids wanting more food
Kids asking for fast food
Culture of food as reward
Value of fast/processed food for the money
Available income for food
Advertising/sponsorship of fast and processed food
Parents purchasing fast food
Ability/time to cook meals
Breast feeding rates
Feeling satisfied
Consumption of water
Perceived water quality
Water taste
Consumption of soft drinks
Price of soft drinks
Sugar consumption
Marketing of processed foods to kids


Engagement of Leadership
Awareness of the Problem
R1
Policy to Reduce Access to SSB
R2
Monitoring
Engagement of Staff – SSB a Problem
Drug and Alcohol Use
Perceived Water Quality
Access to SSB
Parents Refusing Unhealthy Food
Water Consumption
Sweet Drink Consumption
Cost of Bottled Water
Marketing by Industry
Cost of Sweet Drinks
Poor Food Options at Sports Clubs
Access to Free Water
Awareness of Retailers
Engagement of Retailers
Access to Water Via Retail
R3

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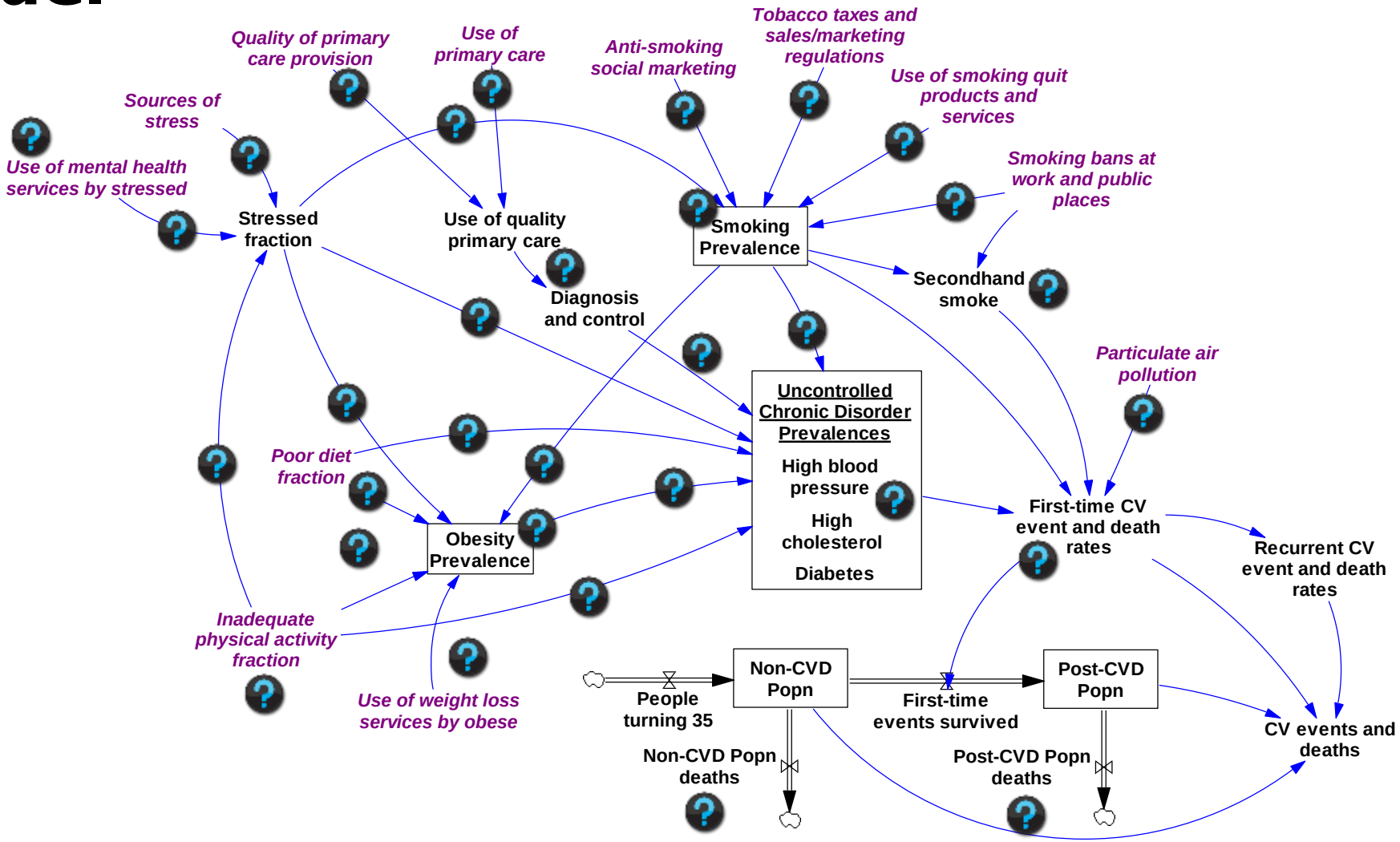
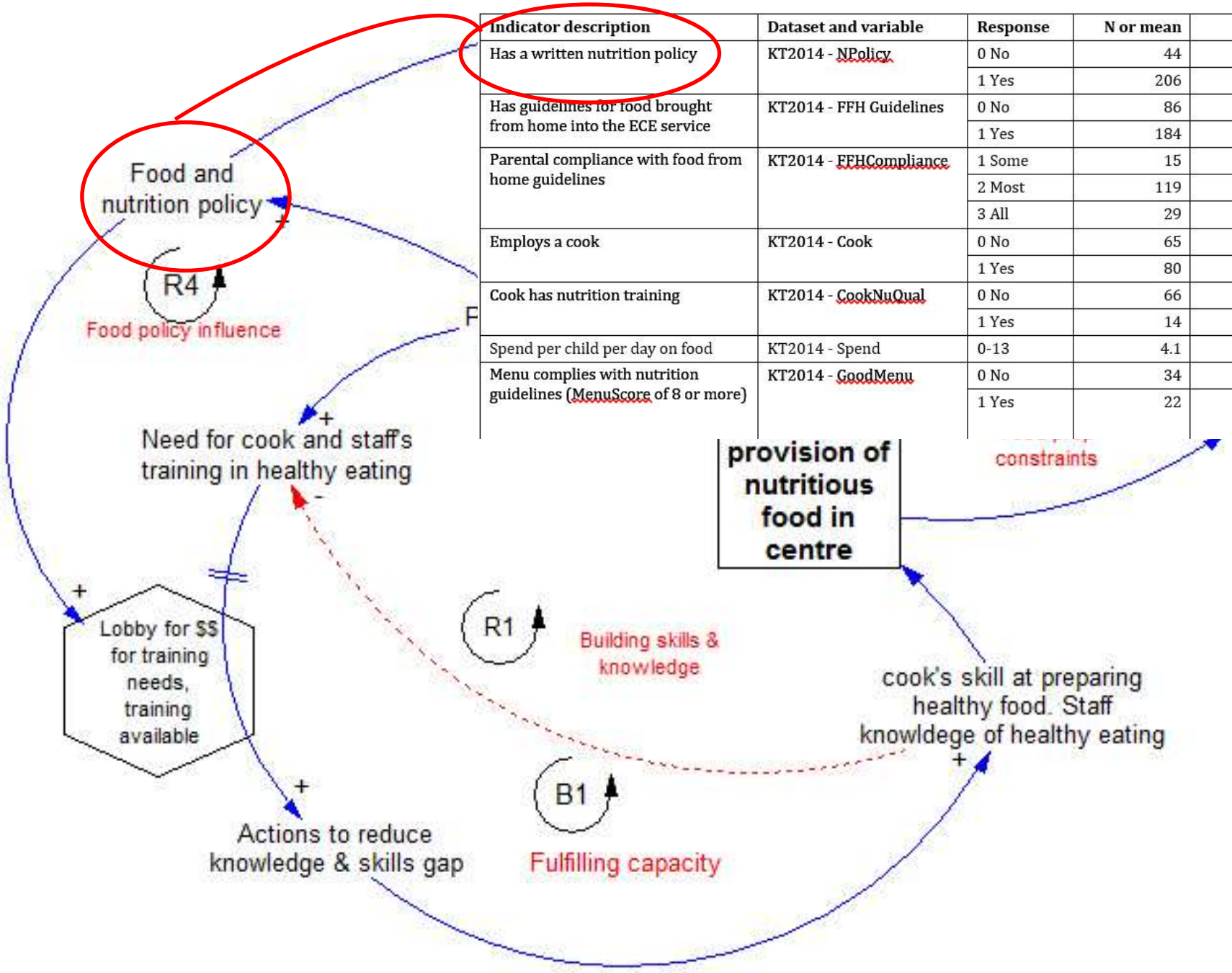
CVD model



Nutrition (working from v5 CLD)

Indicator description	Dataset and variable	Response	N or mean	% or SD	Point on CLD	Notes
Has a written nutrition policy	KT2014 - NPolicy	0 No	44	17.6	R5 ECE Policy	
		1 Yes	206	82.4		
Has guidelines for food brought from home into the ECE service	KT2014 - FFH Guidelines	0 No	86	34.4	R5 ECE Policy	
		1 Yes	184	65.6		
Parental compliance with food from home guidelines	KT2014 - FFHCompliance	1 Some	15	9.2	R4 Parental involvement	
		2 Most	119	72.6		
		3 All	29	17.7		
Employs a cook	KT2014 - Cook	0 No	65	44.8	R8 Funding	
		1 Yes	80	55.2		
Cook has nutrition training	KT2014 - CookNuQual	0 No	66	83.5	R1 Capable cooks	
		1 Yes	14	17.7		
Spend per child per day on food	KT2014 - Spend	0-13	4.1	+/-4.0	R8 Funding	
Menu complies with nutrition guidelines (MenuScore of 8 or more)	KT2014 - GoodMenu	0 No	34	59.6	Centre of CLD (provision of nutritious food in centre)	
		1 Yes	22	38.6		



37 variables / relationships to start quantifying the model

CLD v4 – nutrition: food prepared in ECEs

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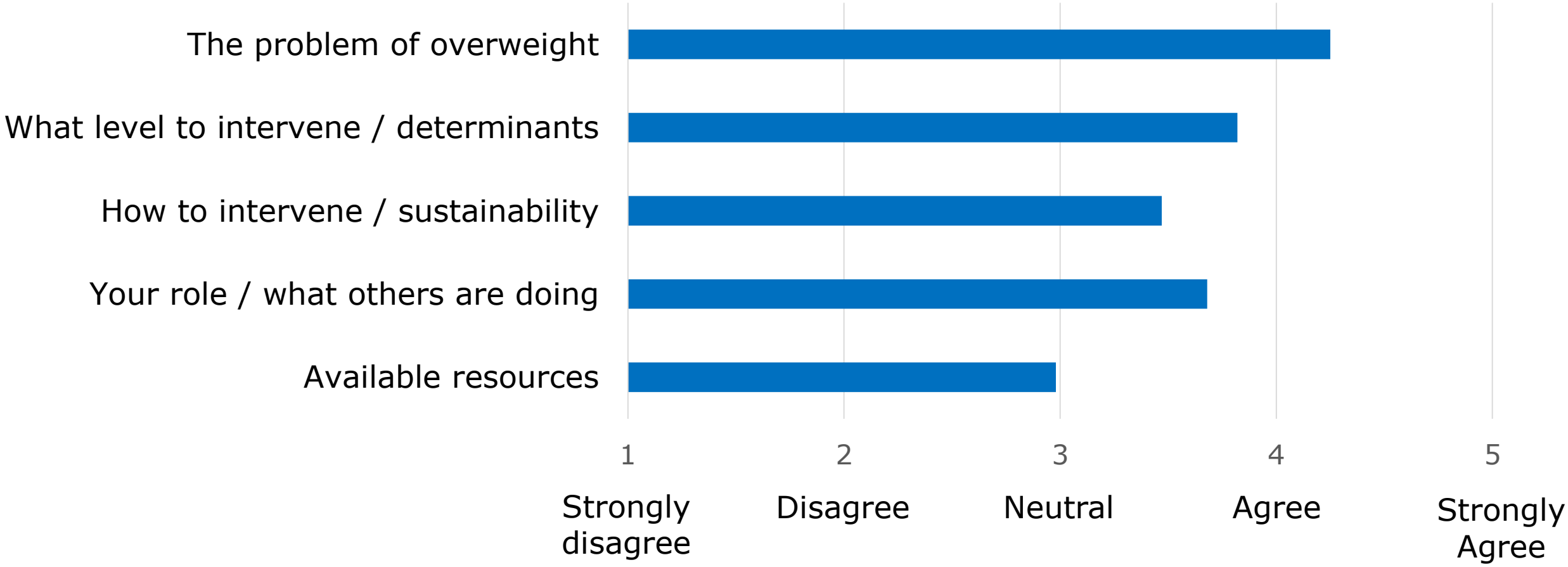
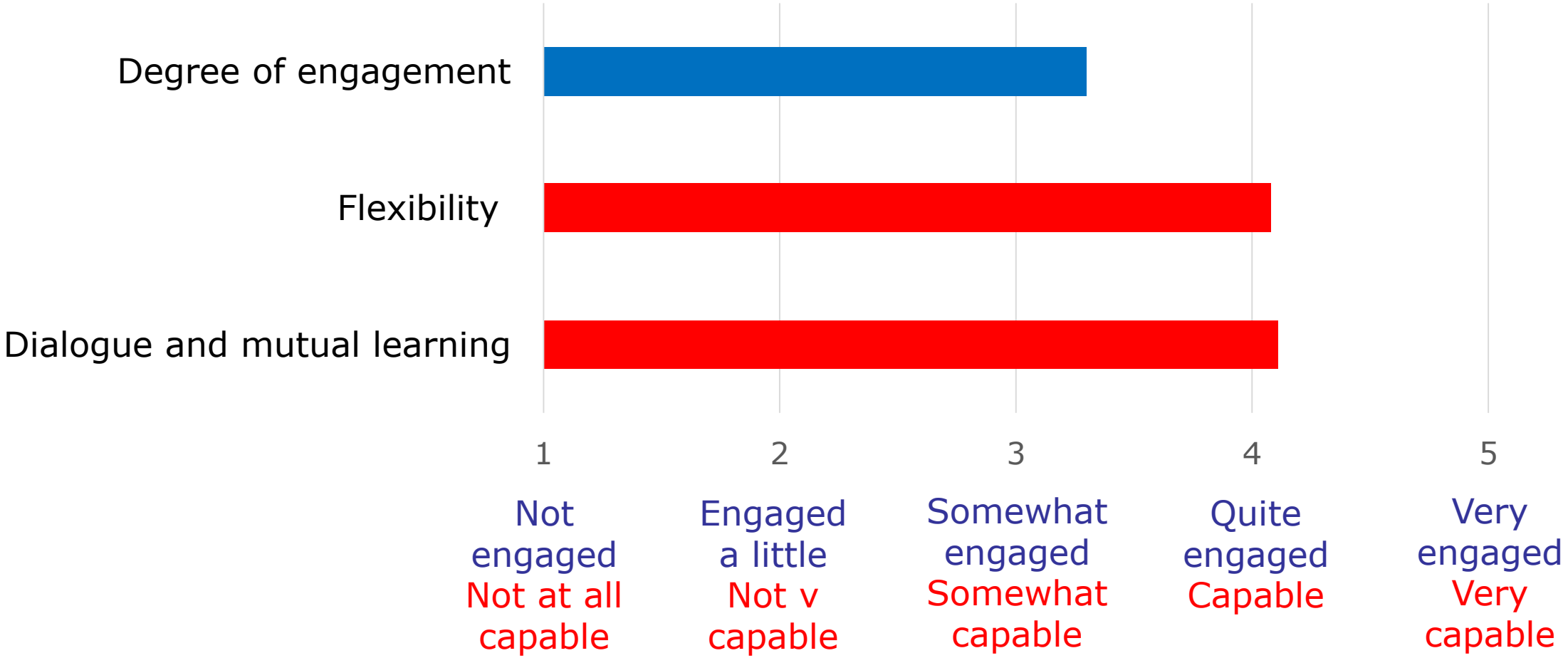
Networks, 'Knowledge' and 'Engagement'

- What flows over networks to stimulate change (community action to prevent obesity)?
- Retrospective analysis from 2 successful programs
- 'Knowledge'
  - Knowing & understanding the problem, how to intervene, how to contribute, what is being done, how to mobilise resources
- 'Engagement'
  - Level of participation, dialogue/mutual learning, flexibility, influence/power, leadership, passion, trust

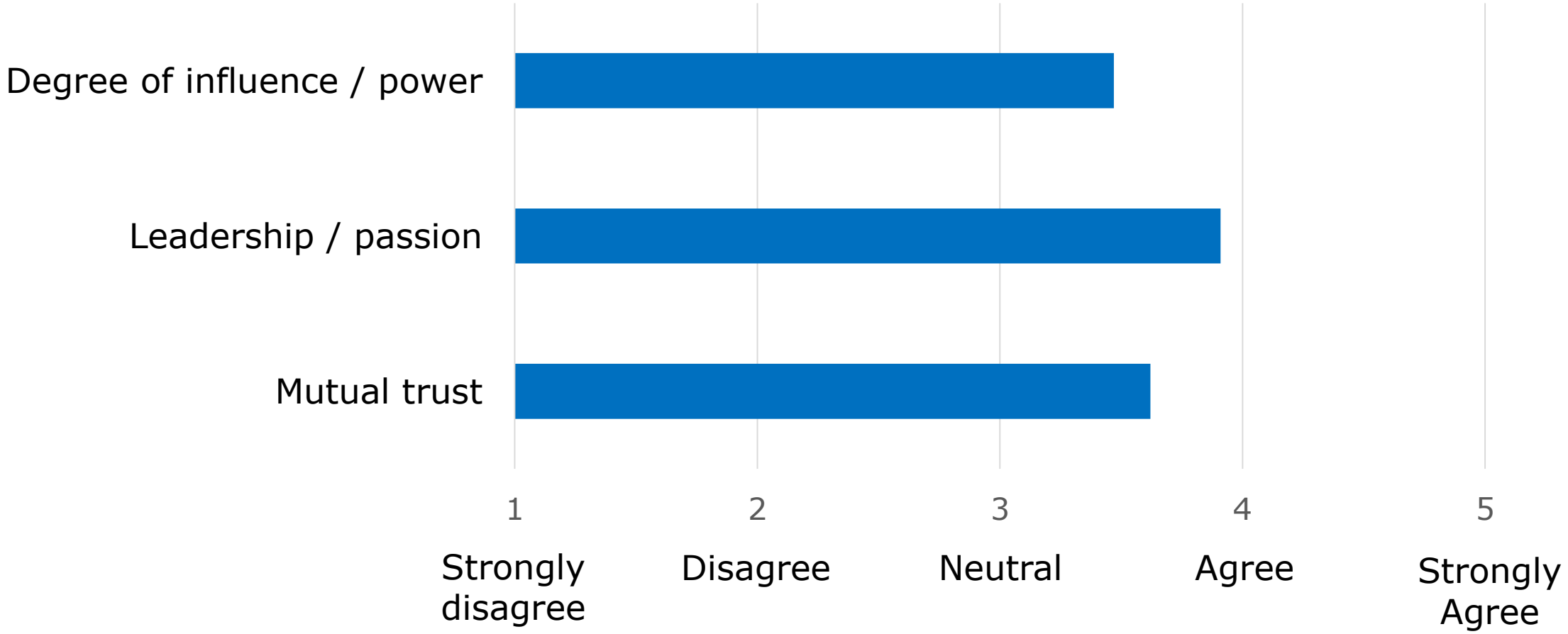
Knowledge


The problem of overweight
What level to intervene / determinants
How to intervene / sustainability
Your role / what others are doing
Available resources
1
2
3
4
5
Strongly disagree
Disagree
Neutral
Agree
Strongly Agree

Engagement 1



Engagement 2



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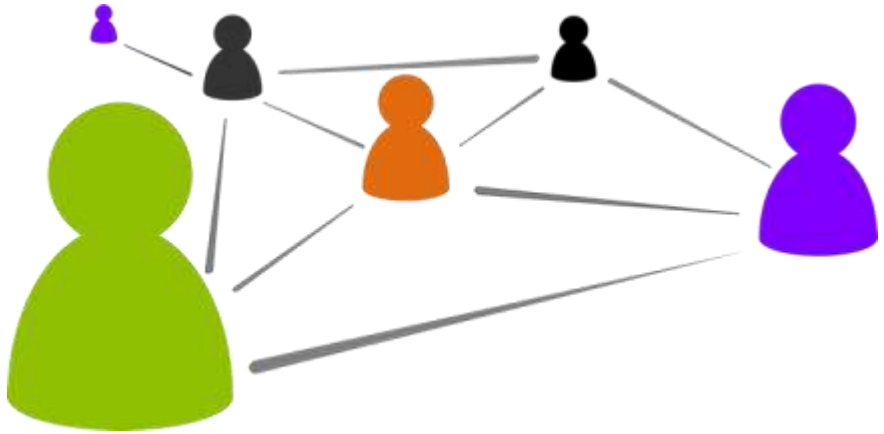
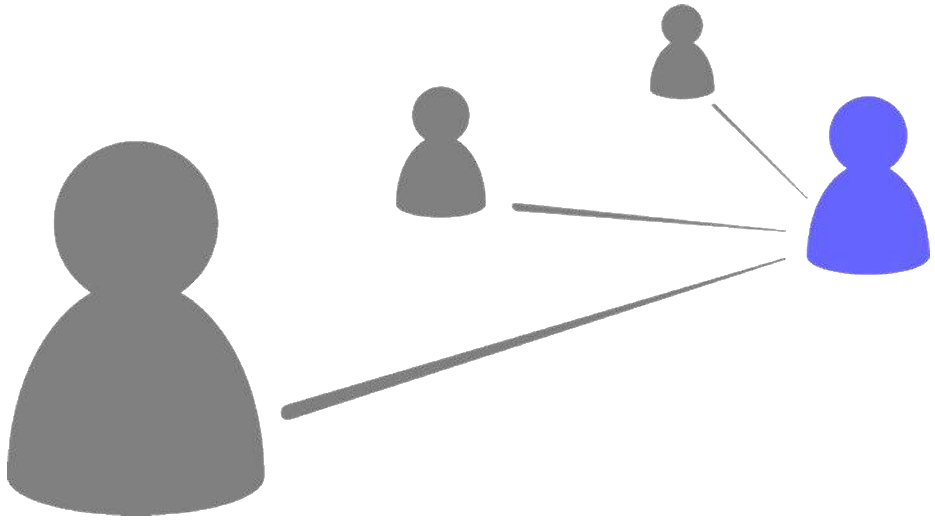
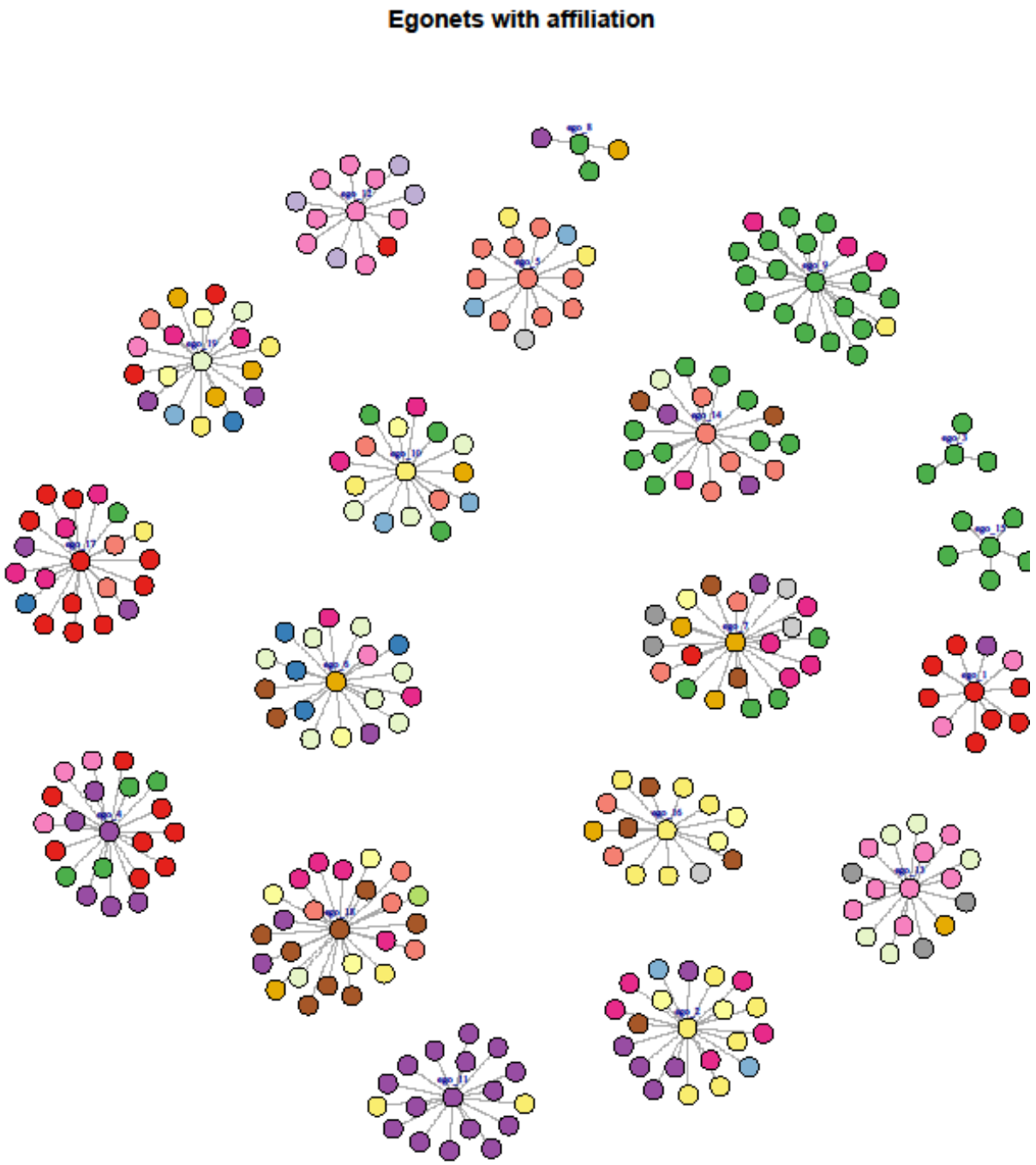
Types of social network analyses

Sociometric



Ego-centric

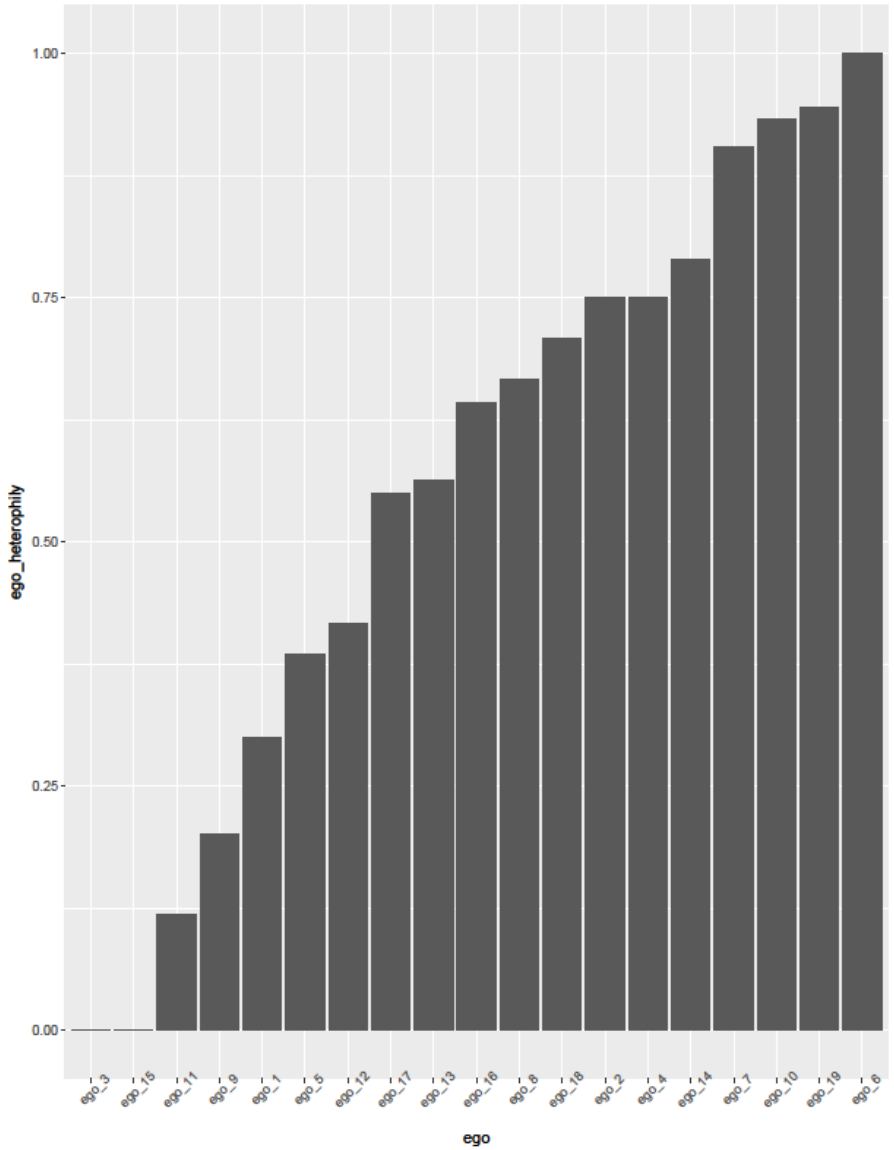




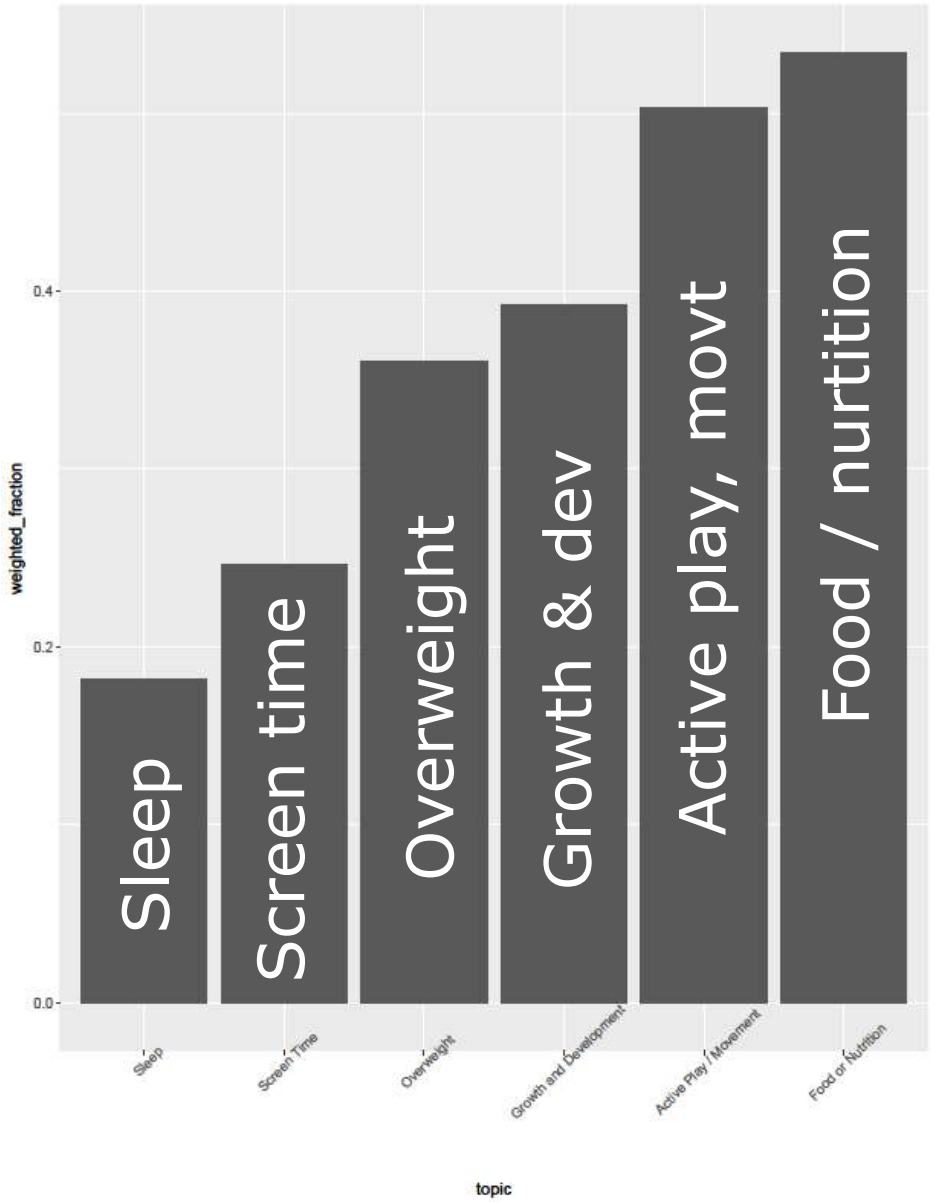
Ego networks with affiliations, directions, strength

- 19 participants
- 288 connections wrt childhood obesity
- 17 primary affiliations
- 18 median connections

Heterophily – discussions in same or different organisations



Discussion topics

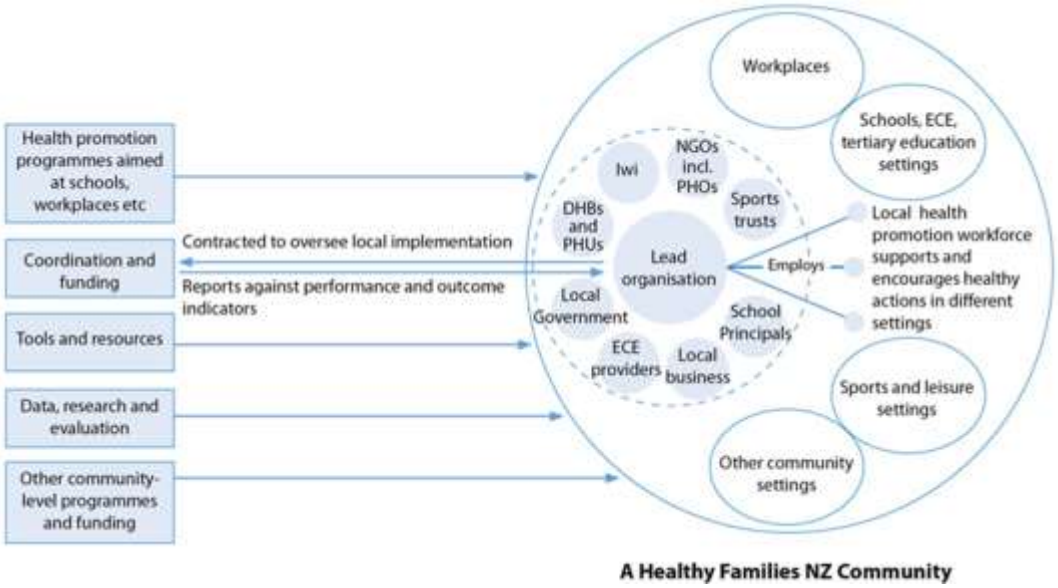


Collective Impact Cascade

Cascade through community networks

	Stage	Authorising	Conceptualising	Validating/ formulating	Actioning
	Who is involved	CEO level	Managers & leaders (Steering Group)	Staff, parents, volunteers	Those with the remit, interest & capacity
	Systems tools	Presentations on systems nature of problem & solutions	Group Model Building workshops	Critique of Causal Loop Diagrams & systems solutions	Communications aligning actions to system objectives
Collective Impact dimensions	**Common agenda**	Ensure shared understanding of the problem and vision for change is agreed for each stage of the cascade			
	Shared measurements	Ensure consistent data on problems (child obesity, behaviours) and solutions (eg policy implementation, settings' food environments) are collected			
	Mutually reinforcing activities	Ensure participant activities are differentiated yet coordinated through a mutually reinforcing plan of action relevant for each stage of the cascade			
	Continuous communications	Ensure consistent and open communication across the many players to build trust, assure mutual objectives, and create common motivation			
	Backbone organisation	Ensure an organization with appropriate staff & skills serves as the backbone for the initiative and coordinates participating organizations and agencies			

Healthy Families NZ



A Healthy Families NZ Community

- Other national and regional activities eg
  - Fruit in schools
  - Healthy Auckland Together, Healthy Christchurch
  - Project Energize

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HEALTHY AUCKLAND TOGETHER

http://www.healthyaucklandtogether.org.nz/

- Regional PH service provides backbone support
- All major Auckland organisations participating
- 1 year – joining up, learning about each other, developing plans, obtaining mandates etc
- Injected $$ = 3 Healthy Families NZ sites, ARPHS
- Challenges
  - Undertaking systems change across the region using existing resources
  - Measuring the impacts of the efforts

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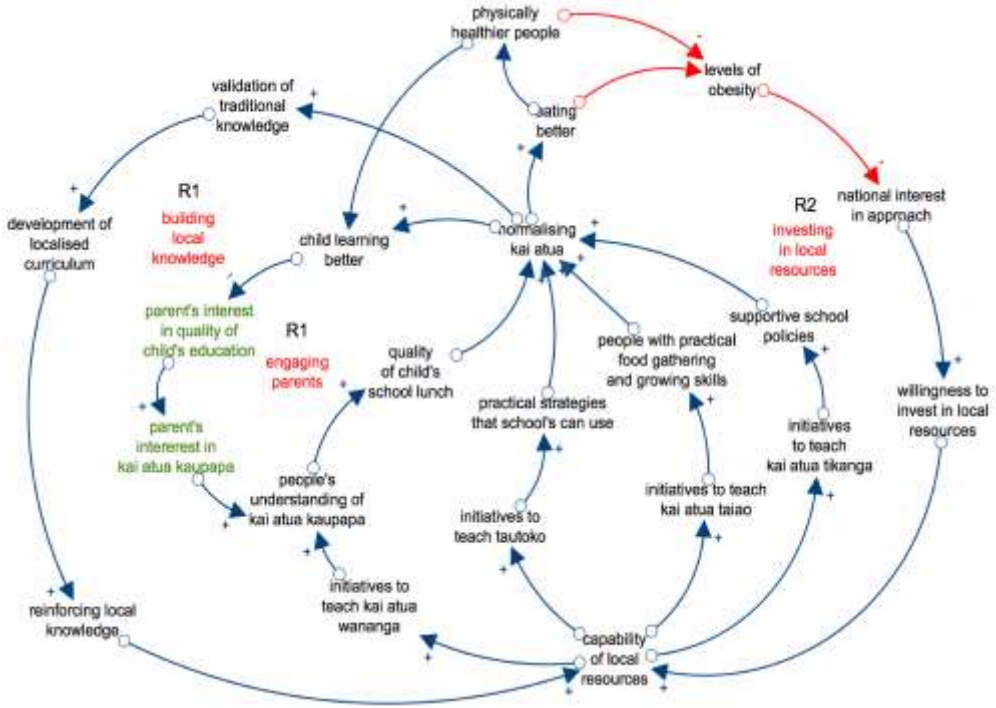
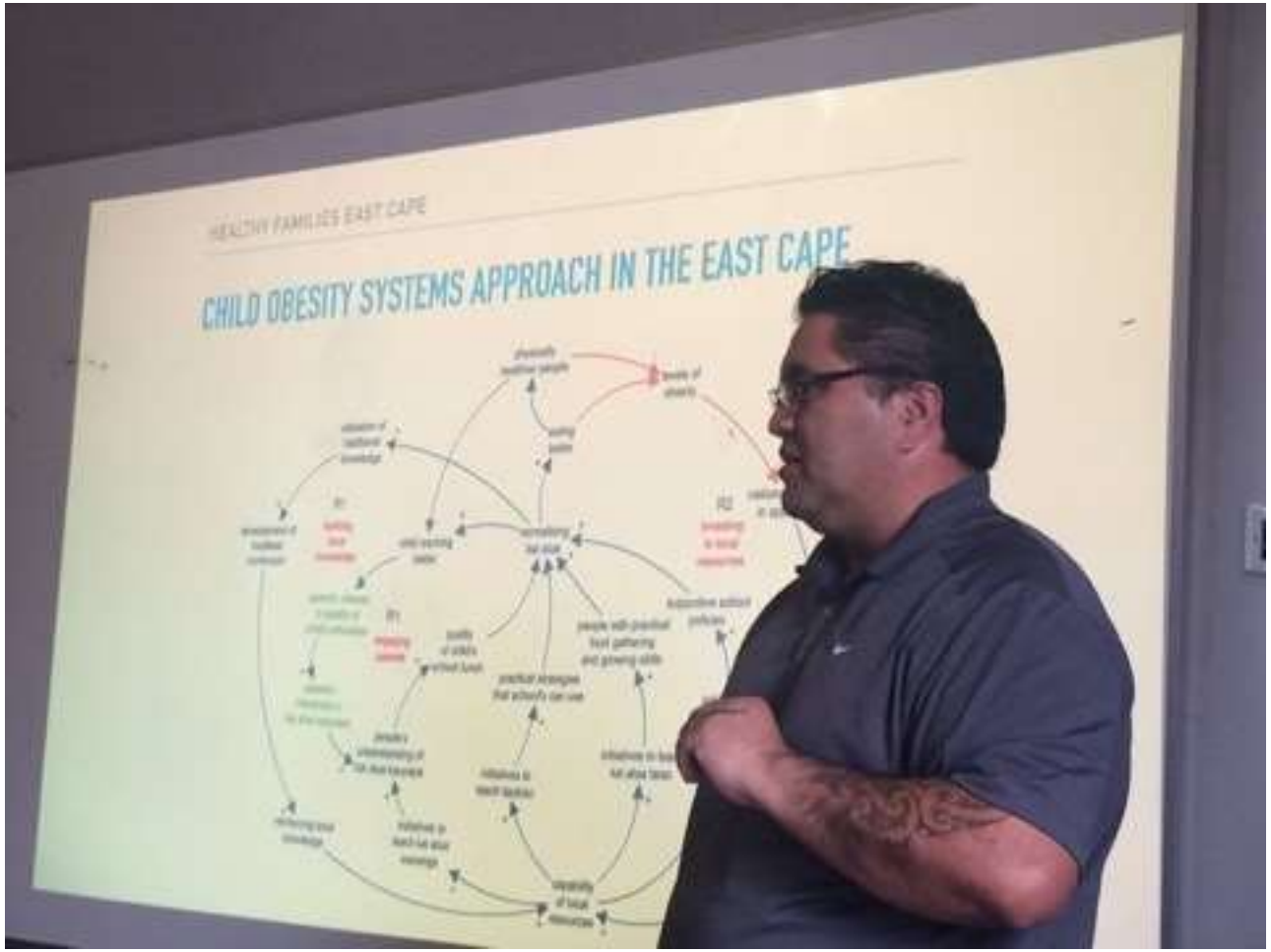
Indigenous approaches to obesity prevention





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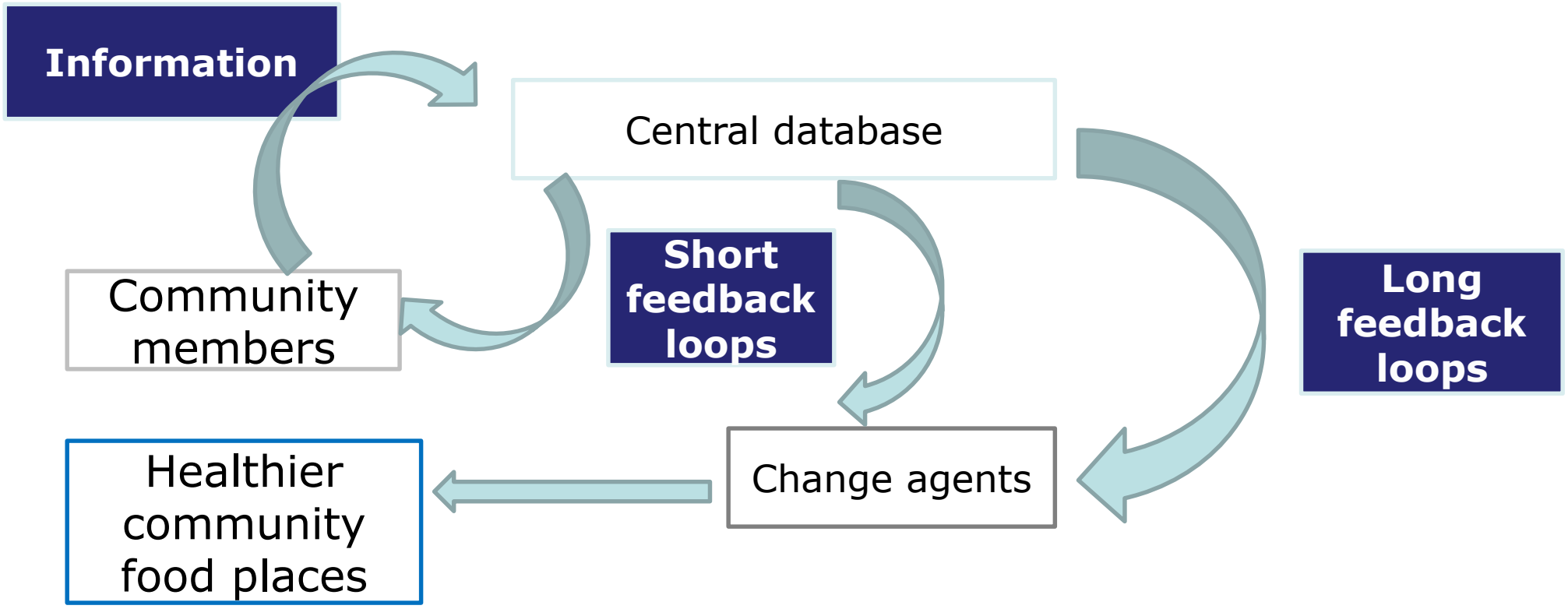
The *FoodBack* System



Information and short feedback loops = Food data, pictures, location data, best practice stories, comments

Long feedback loop = Analyses, badges, best practice benchmarks

Strengths of systems approaches

1. Engagement
   - Creating joint understandings of the problems and solutions
   - Group Model Building
2. Truer picture of the problem
   - Embracing the complexity
   - Using the dynamics
   - More tools for understanding and evaluations
3. Levels of intervention
   - Variables
   - Relationships
   - Rules, goals

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Conclusions

- Shift to systems thinking is a step change for obesity prevention
- Still understanding how to communicate it, apply it, and measure it
- Need to exploit the spread of the ‘prevention virus’ and ‘community bootstrap’ processes
- Need systems tools as well as linear null hypothesis testing tools (G1-G3)
- Population monitoring data is essential
- Pool our lessons and create preventions systems for NZ