Reducing Waste in Research: Use of Taxonomies and Frameworks of Behaviour Change

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Mind the Gap webinar March 2016

UCL Centre for Behaviour Change

This talk

1. Opportunities for advancing behavioural science efficiently
   - improve reporting, fidelity of delivery and use of theory
2. Future vision:
   - developing an ontology of behaviour change interventions

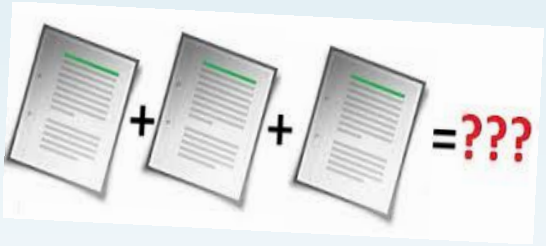
A foundation on which to build

- We have a rich s…thods for intervention de…
- Considerable …med at individuals, co… …ns
  - Trials: estimated … …nge interventions per day
- Most have mode… and variable effects
  - *e.g. reviews fro… Cochrane database, National Institute for Clinical and Healthcare Excellence (NICE)*

How can we improve this situation?

Opportunities for advance …

- Accumulating evidence efficiently
  1. Replicate for incremental advance
     - Explicitly build on past work rather than start anew or present as 'new'



  2. Minimise waste in research
     - Improve reporting, fidelity of delivery and use of theory … for replication and evidence synthesis
  3. Co-ordinate vs fragment
     - To maximise effectiveness and efficiency of building evidence and advancing theory
     - Frameworks useful for this purpose

THE LANCET

Research: increasing value, reducing waste 5

Reducing waste from incomplete or unusable reports of biomedical research

Paul Glasziou, Douglas G Altman, Patrick Bossuyt, Isabelle Boutron, Mike Clarke, Steven Julious, Susan Michie, David Moher, Elizabeth Wager

- 40–89% interventions non-replicable
- Recommendations include
  - High quality and complete reporting demanded by journals, authors and peer reviewers
    - use reporting guidelines

Glasziou et al, *Lancet*, 2014

Interventions to change behaviour

- Most are complex
  - Made up of many interacting components
- To design more effective interventions, need to
  - know what the components are and why they work
  - unpack the “black box” of interventions

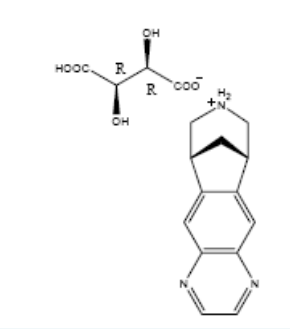
→ **Effect**

- What is in the black box? [content]
- Why do components have their effect? [theory]

Biomedicine vs behavioural science …
example of smoking cessation interventions

Varenicline *JAMA*, 2006

- Intervention content



- Mechanism of action
  - Activity at a subtype of the nicotinic receptor where its binding produces agonistic activity, while simultaneously preventing binding to a4b2 receptors

Behavioural counselling *Cochrane*, 2005

- Intervention content
  - Review smoking history & motivation to quit
  - Help identify high risk situations
  - Generate problem-solving strategies
  - Non-specific support & encouragement
- Mechanism of action
  - *None mentioned*

Specify the "What": varying terminology

Title of journal article	Description of "behavioural counseling"
The impact of ***behavioral counseling*** on stage of change fat intake, physical activity, and cigarette smoking in adults at increased risk of coronary heart disease	"***educating*** patients about the benefits of lifestyle change, encouraging them, and suggesting what changes could be made" (Steptoe et al. *AJPH* 2001)

Effects of internet ***behavioral counseling*** on weight loss in adults at risk for Type 2 diabetes	"***feedback*** on ***self-monitoring*** record, ***reinforcement***, recommendations for change, answers to questions, and general support" (Tate et al. *JAMA* 2003)

‘What’ of interventions: describing content using a shared language

- One method: Behaviour change techniques (BCTs)
  - Have the *potential* to be the ‘active ingredients’ of an intervention
  - Observable and replicable
  - Aim to be the smallest components that on their own can bring about change
  - Can be used alone or in combination with other BCTs

"Taxonomies" of BCTs

- Physical activity/healthy eating/mixed : 26 BCTs
  Abraham & Michie , 2008
- Physical activity & healthy eating: 40 BCT
  Michie et al, Psychology & Health, 2011
- Smoking cessation: 53 B
  Michie et al, Annals behavio
- Reducing exc 42 BCTs
  Michie et al, Ad
- Condo
  Abra
- G viour change: 137 BCTs
  Michie et al, Applied Psychology: An International Review, 2008
- Competence framework: 89 BCTs
  Dixon & Johnston, 2011

Fragmentation rather than integration

Bringing the taxonomies together, 2010-13

Michie, Johnston, Abraham, Francis, Hardeman, Eccles, Wood, Cane, Richardson

To develop a unified taxonomy using literature and expert consensus

- 400 participants from 12 countries across a range of disciplines

BCT International Advisory Board

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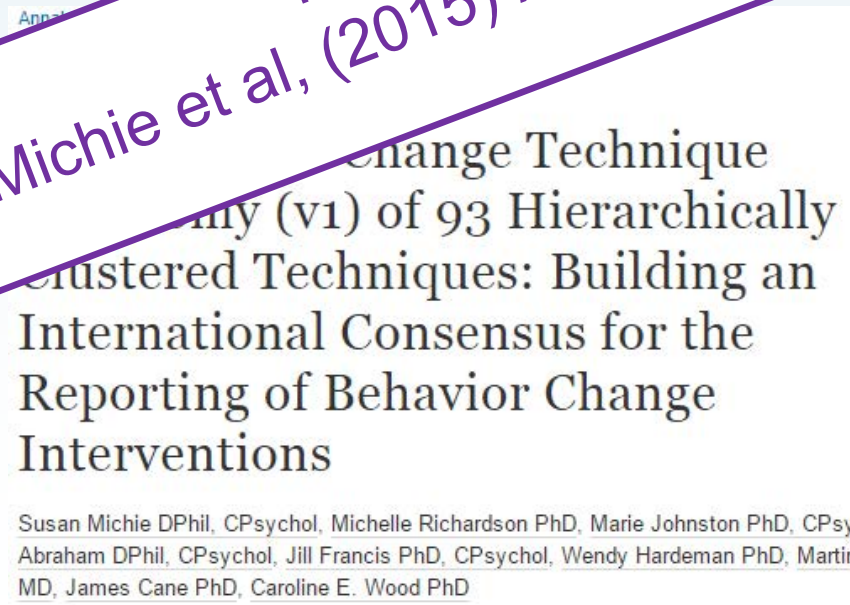
Results

- 93 clearly labelled, well defin[illegible]e BCTs
- Hierarchically [illegible]groupings to improv[illegible]

Full programme of work, 5 studies, Michie et al, (2015) Health Technology Assessment, 19 (99)

[illegible]et al, *BJHP*, 2014



[illegible]Change Technique
[illegible]ny (v1) of 93 Hierarchically
[illegible]ustered Techniques: Building an International Consensus for the Reporting of Behavior Change Interventions

Susan Michie DPhil, CPsychol, Michelle Richardson PhD, Marie Johnston PhD, CPsychol, Charles Abraham DPhil, CPsychol, Jill Francis PhD, CPsychol, Wendy Hardeman PhD, Martin P. Eccles MD, James Cane PhD, Caroline E. Wood PhD

Article Metrics

199 Citations

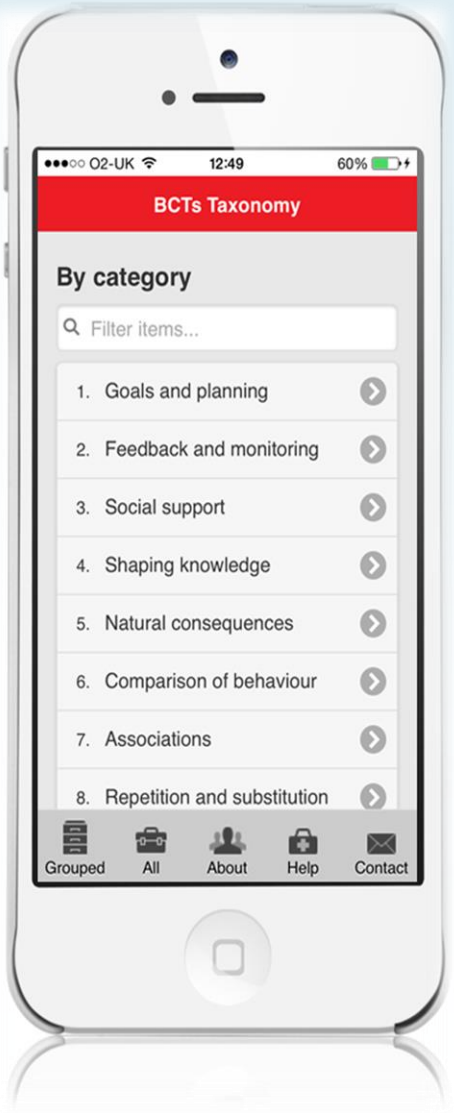
63 Social

BCT Taxonomy v1: 93 items in 16 groupings

Page	Grouping and BCTs	Page	Grouping and BCTs	Page	Grouping and BCTs
1	**1. Goals and planning**	8	**6. Comparison of behaviour**	16	**12. Antecedents**
	1.1. Goal setting (behavior) 1.2. Problem solving 1.3. Goal setting (outcome) 1.4. Action planning 1.5. Review behavior goal(s) 1.6. Discrepancy between current behavior and goal 1.7. Review outcome goal(s)		6.1. Demonstration of the behavior 6.2. Social comparison 6.3. Information about others' approval		12.1. Restructuring the physical environment 12.2. Restructuring the social environment 12.3. Avoidance/reducing exposure to cues for the behavior 12.4. Distraction 12.5. Adding objects to the
		9	**7. Associations**		
			7.1. Prompts/cues		

No.	Label	Definition	Examples
1. Goals and planning			
1.1	***Goal setting (behavior)***	Set or agree on a goal defined in terms of the behavior to be achieved *Note: only code goal-setting if there is sufficient evidence that goal set as part of intervention; if goal unspecified or a behavioral outcome, code **1.3, Goal setting (outcome)**; if the goal defines a specific context, frequency, duration or intensity for the behavior, also code **1.4, Action planning***	Agree on a daily walking goal (e.g. 3 miles) with the person and reach agreement about the goal Set the goal of eating 5 pieces of fruit per day as specified in public health guidelines

The BCTTv1 smartphone app



- Fully searchable version of BCTTv1
- Search by BCT label, BCT grouping or alphabetically
- To increase
  - familiarity with the taxonomy
  - speed and recall of BCT labels and definitions

Search for: BCTs

Search for: BCTs

bcts.23.co.uk

bcts.23.co.uk

www.bct-taxonomy.com

Feedback and plans for updating BCTTv1

Please **click here for the BCTTv1 online feedback form**.

http://www.ucl.ac.uk/behaviour-change-techniques/BCTTv1Feedback

BCTTv1 was developed with the understanding that, in a few years, feedback from international users would lead to the development of BCTTv2.

In order to inform this development, we encourage users of BCTTv1 to submit information about their experiences within this portal. We would be grateful for any feedback and suggestions you have, including:

- Additional BCTs not in BCTTv1
- Amendments to labels or definitions of specific BCTs
- BCTs found to be difficult to use
- Adaptations or translations of BCTTv1
- Reliability data
- General suggestions for improvement

With many thanks for your contribution. All those submitting information considered by the future reviewing consortium will be acknowledged. We anticipate data will be formally reviewed in 2017.

Best wishes,

The BCTTv1 Team.

This talk

1. Opportunities for advancing behavioural science efficiently
   - improve reporting, fidelity of delivery and use of theory
2. Future vision:
   - developing an ontology of behaviour change interventions

Fidelity: What is reported and what is delivered? Example of smoking cessation

- BCT analysis of protocols and delivery of behavioural support for smoking cessation
  - Protocols of interventions from Cochrane reviews
    - <50% of BCTs specified in protocols were reported in publications, Lorencatto et al, 2012, *N&TR*
  - Delivery in practice
    - 41% of protocol-defined BCTs delivered in 54 behavioural support sessions, Lorencatto et al, 2013, 2014; *J Cons & Clin Psy*
      - reliable measure, Lorencatto et al, 2013, *Imp Sci*

BCT methodology provides an agreed, standard method to

- Describe interventions as accurately as possible
  - Replicate interventions to generate evidence
  - Assess fidelity
  - Implement effective interventions
- Evaluate e.g. in systematic reviews or factorial designs
  - Identify active ingredients (what)
  - Investigate mechanisms of action (how)
- Design interventions
  - BCTs linked to broader intervention frameworks

Designing BC interventions: using theory and integrative frameworks

- Some approaches:
  1. One or several theories
  2. An integrative framework
     - e.g. Behaviour Change Wheel, Michie et al, 2011, a synthetic framework that can be used to select BCTs in intervention design www.behaviourchangewheel.com

  3. An ontology
     - a structure that systematically represents & organises the essential elements relating to interventions

Why theory? To build knowledge efficiently

1. Summarises current state of knowledge
2. Structures thinking and guides research
3. Provides a framework to facilitate
   - communication across research groups
   - accumulation of evidence
     - Mechanisms of action ('mediators')
     - Explanations for variation ('moderators')

Applying theory to developing and evaluating BC interventions

Can we be more efficient in applying theory?

Reported use of theories

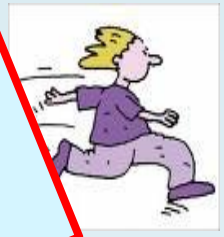
- A review of 190 studies of interventions to increase physical activity & healthy eating[1]
  - 56% studies explicitly reported using theory
    - Application of theory analysed by the 19 item Theory Coding Scheme [2]

Intervention (BCTs) → ? → Theoretical constructs → ? → Behaviour

- 90% studies: there were BCTs not linked to theoretical constructs
- 91% studies: there were constructs not targeted by BCTs

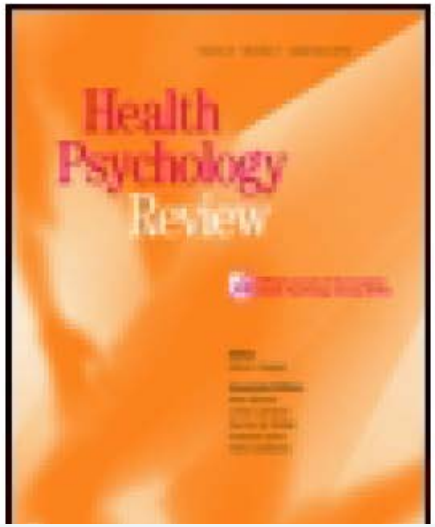
[1]Prestwich et al, 2014, *Health Psych;* [2] Michie et al, 2011, *Health Psych*

Use of theories



- Limited range of theorie
  - Of the 56% studi
  - 2 theorie
    - el (n=58)
    - ies: n=45

Are there potentially useful theories that are under-used?



Health Psychology Review

Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/rhpr20

Theories of behaviour and behaviour change across the social and behavioural sciences: a scoping review

Rachel Davis[a], Rona Campbell[b], Zoe Hildon[a], Lorna Hobbs[a] & Susan Michie[a]

Cross-disciplinary literature review with Advisory group from psychology, sociology, anthropology and economics

Findings

- 83 theories
  - Summary of original description
  - List of constructs
    - **1725**; mean **21**, range **5-84**
  - Network diagram of source theories
  - Future: Searchable website

Michie et al, www.behaviourchangetheories.com, 2014

1. Action Theory Model of Consumption
2. Affective Events Theory
3. Aids Risk Reduction Model
4. Behavioural-Ecological Model of Adolescent Aids Prevention
5. CEOS Theory
6. Change Theory
7. Classical Conditioning
8. COM-B System
9. Consumption as Social Practices
10. Containment Theory
11. Control Theory
12. Differential Association Theory
13. Diffusion of Innovations
14. Ecological Model for Preventing Type 2 Diabetes in Minority Youth
15. Extended Information Processing Model
16. Extended Parallel Processing Model
17. Feedback Intervention Theory
18. Focus Theory of Normative Conduct
19. General Theory of Crime
20. General Theory of Deviant Behaviour
21. Goal Directed Theory
22. Goal-Framing Theory
23. Goal Setting Theory
24. Health Action Process Approach
25. Health Behaviour Goal Model
26. Health Behaviour Internalisation Model
27. Health Belief Model
28. Health Promotion Model
29. I-Change Model
30. Information-Motivation-Behavioural Skills Model
31. Information-Motivation-Behavioural Skills Model of Adherence
32. Integrated Theoretical Model for Alcohol and Other Drug Abuse Prevention
33. Integrated Theory of Drinking Behaviour
34. Integrated Theory of Health Behaviour Change
35. Integrative Model of Behavioural Prediction
36. Integrative Model of Factors Influencing Smoking Behaviour
37. Integrative Model of Health Attitude and Behaviour Change
38. Integrative Model of Factors Influencing Smoking And Attitude And Health Behaviour Change
39. Model of Pro-Environmental Behaviour
40. Motivation-Opportunities-Abilities Model
41. Needs-Opportunities-Abilities Model
42. Norm Activation Theory

43. Operant Learning Theory
44. Precaution Adoption Process Model
45. Pressure System Model
46. PRIME Theory
47. Problem Behaviour Theory
48. Prospect Theory
49. Protection Motivation Theory
50. Prototype Willingness Model
51. Rational Addiction Model
52. Reflective Impulsive Model
53. Regulatory Fit Theory
54. Relapse Prevention Model
55. Risk as Feelings Theory
56. Self-Determination Theory
57. Self-Efficacy Theory
58. Self-Regulation Theory
59. Six Staged Model of Communication Effects
60. Social Action Theory (1)
61. Social Action Theory (2)
62. Social Change Theory
63. Social Cognitive Theory
64. Social Consensus Model of Health Education
65. Social Development Model
66. Social Ecological Model of Behaviour Change
67. Social Ecological Model of Walking
68. Social Identity Theory
69. Social Influence Model of Consumer Participation
70. Social Learning Theory
71. Social Norms Theory
72. Systems Model of Health Behaviour Change
73. Technology Acceptance Model 1, 2 & 3
74. Temporal Self-Regulation Theory
75. Terror Management Theory
76. Terror Management Health Model
77. Theory of Interpersonal Behaviour
78. Theory of Normative Social Behaviour
79. Theory of Planned Behaviour
80. Theory of Triadic Influence
81. Transcontextual Model of Motivation
82. Transtheoretical Model of Behaviour Change
83. Value Belief Norm Theory

Observations from conducting the review

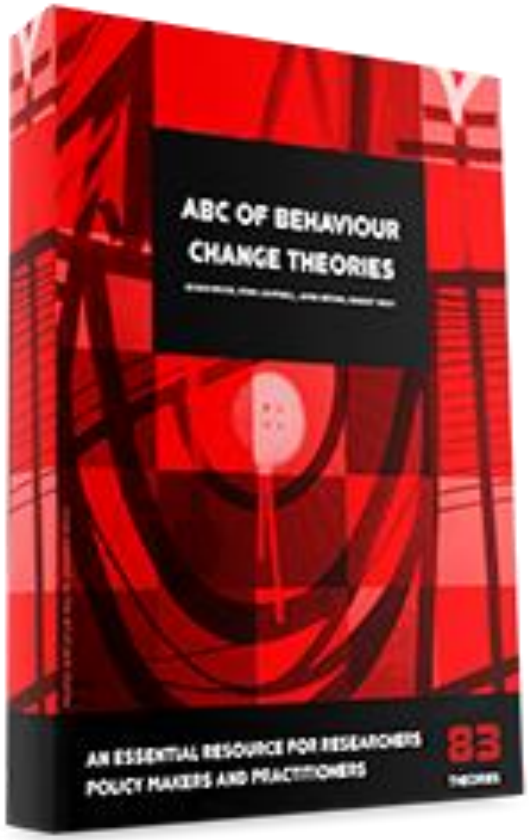
- Theories
  - not efficient to have 83 theories; much overlap
  - most are partial accounts
    - 3 of the 83 identified set out to be integrative
- Constructs
  - many appear the same or similar
  - lack of correspondence between labels and definitions
- Theory descriptions
  - Opportunity to increase efficiency and advance our science by more precisely defining constructs and specifying the type of relationships between them

Specifying theory precisely: current work

- Using online diagram software, specify types of relationship between constructs within 83 theories
  - 11 identified relationships
  - results checked with theory authors
- Also specify relationships across theories
  - Which constructs are the same/similar/different
- Collaboration with computer science to
  - classify mechanisms of action
  - develop one or more 'prototype' theories to form the core of a network of more specific theories

A suggested template for reporting theory

Item	Description
Name	
Brief summary	
Scope	
Target	
Type	
Rationale	
Constructs	
Relationships	
Provenance	
Similarity	
Complementarity	
Operationalisation	
Hypotheses	
Uses	



2. Frameworks of behavioural interventions

- Frameworks make life easier
  - good frameworks make you more
- Need a framework that i
  - Comprehensive
    - So you don't … effective
  - Coheren…
    - So … tematic method for intervention design
  - Lin… …odel of behaviour
    - So that you can draw on behavioural science

Useable by, and useful to, policy makers, service planners and intervention designers

Do we have such a framework?

- Systematic literature review identified 19 frameworks of behaviour change interventions
  - related to health, environment, culture change, social marketing etc. E.g Mindspace, Intervention Mapping
- None met all these three criteria
- So …. Developed a synthesis of the 19 frameworks

Michie et al (2011) The Behaviour Change Wheel: a new method for characterising and designing behaviour change interventions, *Implementation Science*

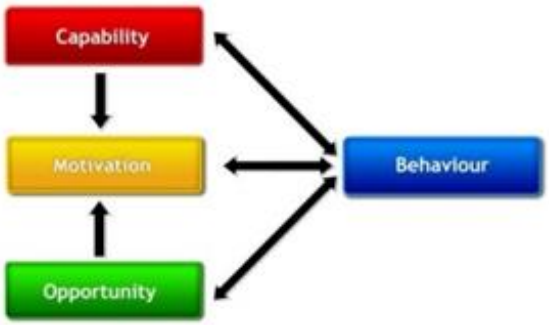
www.behaviourchangewheel.com

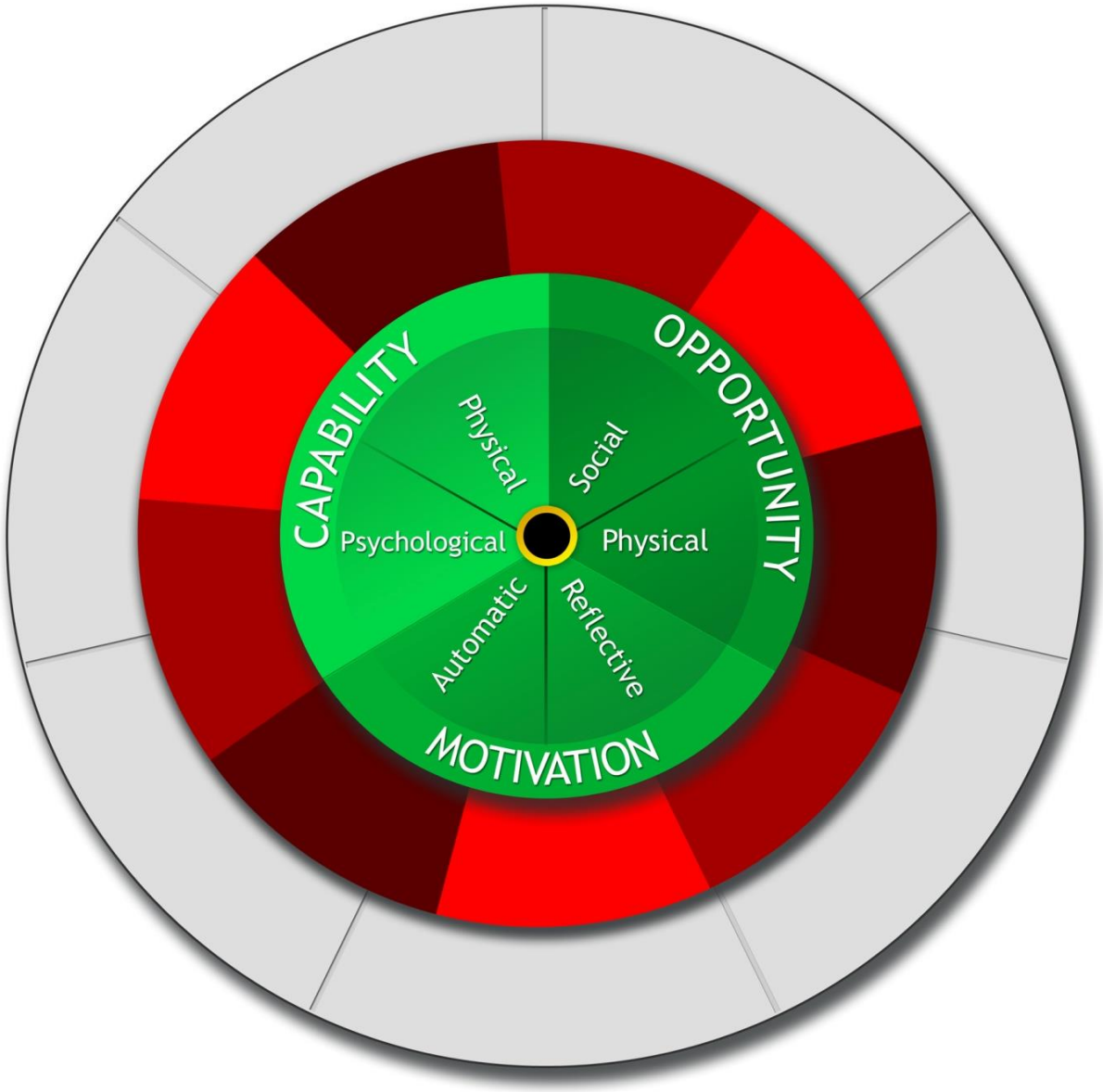
Behaviour at the hub …. COM-B

Sources of behaviour

Intervention functions

Policy categories





Interventions

Sources of behaviour

Intervention functions

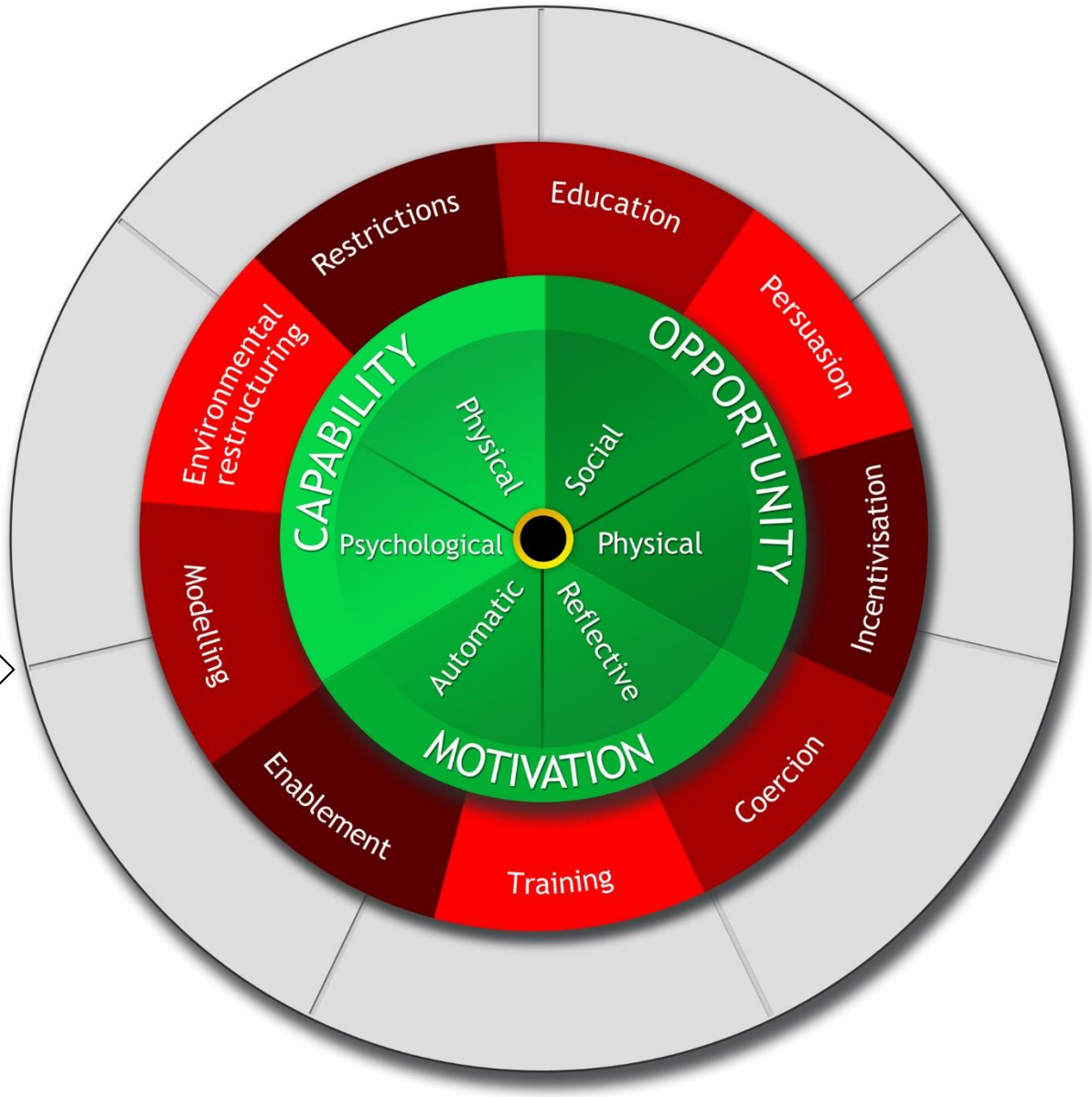
Interventions: activities designed to change behaviours

Sources of behaviour

Intervention functions

Policy categories

Add policies to maintain change **long-term**

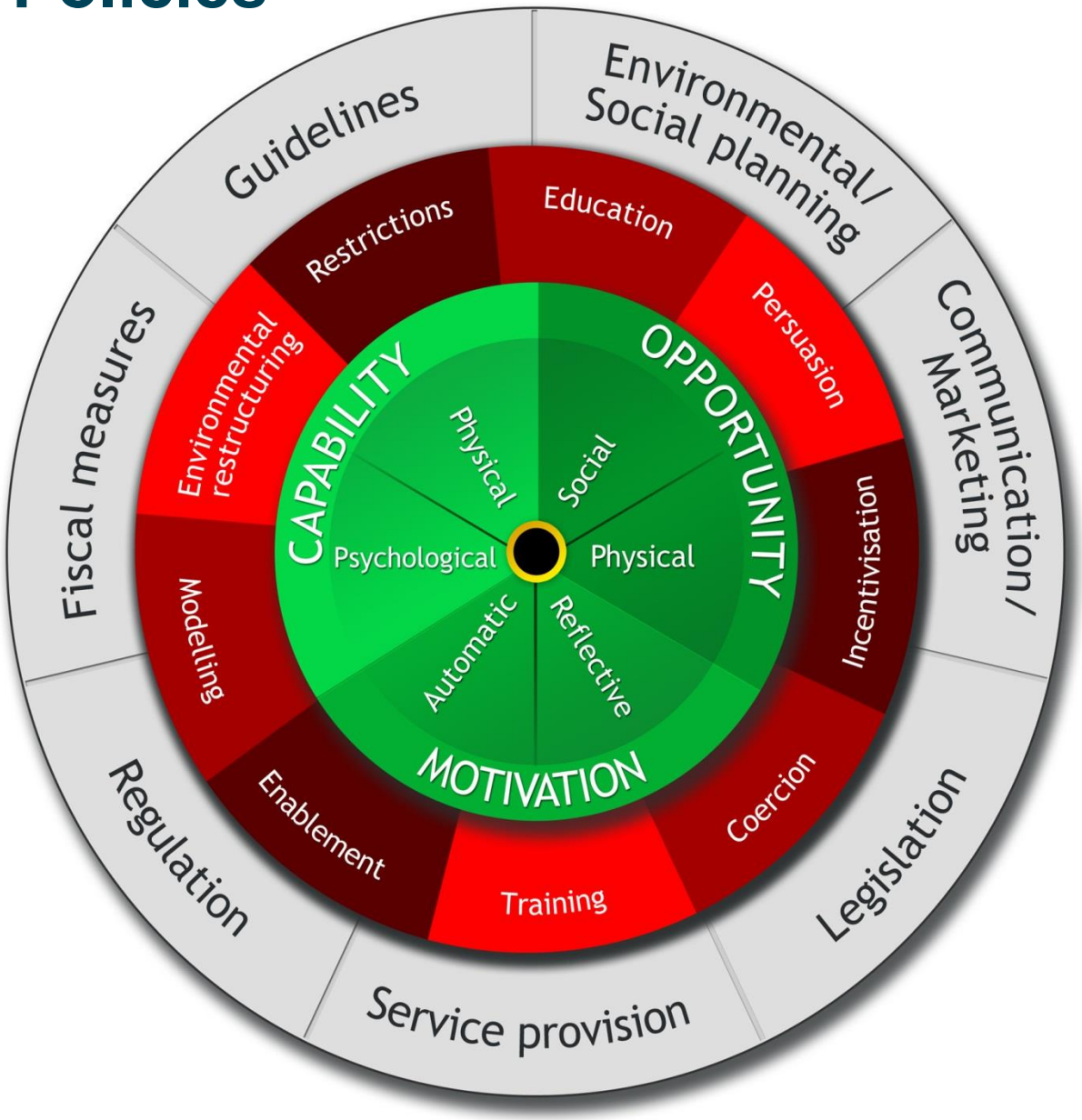


Policies

Sources of behaviour

Intervention functions

Policy categories



Policies: decisions made by authorities concerning interventions

Michie et al (2011) The Behaviour Change Wheel: a new method for characterising and designing behaviour change interventions *Implementation Science*

Some applications of Behaviour Change Wheel

India
- Smartphone app to reduce cardiovascular disease risk

Kenya
- Improve paediatric health care

Netherlands
- An organisational intervention tool

Thailand
- Preventing melioidosis

USA
- Improving colorectal cancer screening
- Providing long-acting reversible contraception to adolescents
- Improve parenting practices for children with challenging behaviour

UK
- Smartphone app for parents of overweight children
- Promote recycling behaviours in university staff and students
- Reduce cardiovascular disease risk in people with severe mental illness
- Improve management of postnatal depression
- Smartphone app to promote attentive eating
- Internet intervention to promote condom use

Papua New Guinea
- Change Betel nut chewing behaviour

International Red Cross
- Train volunteers

This talk

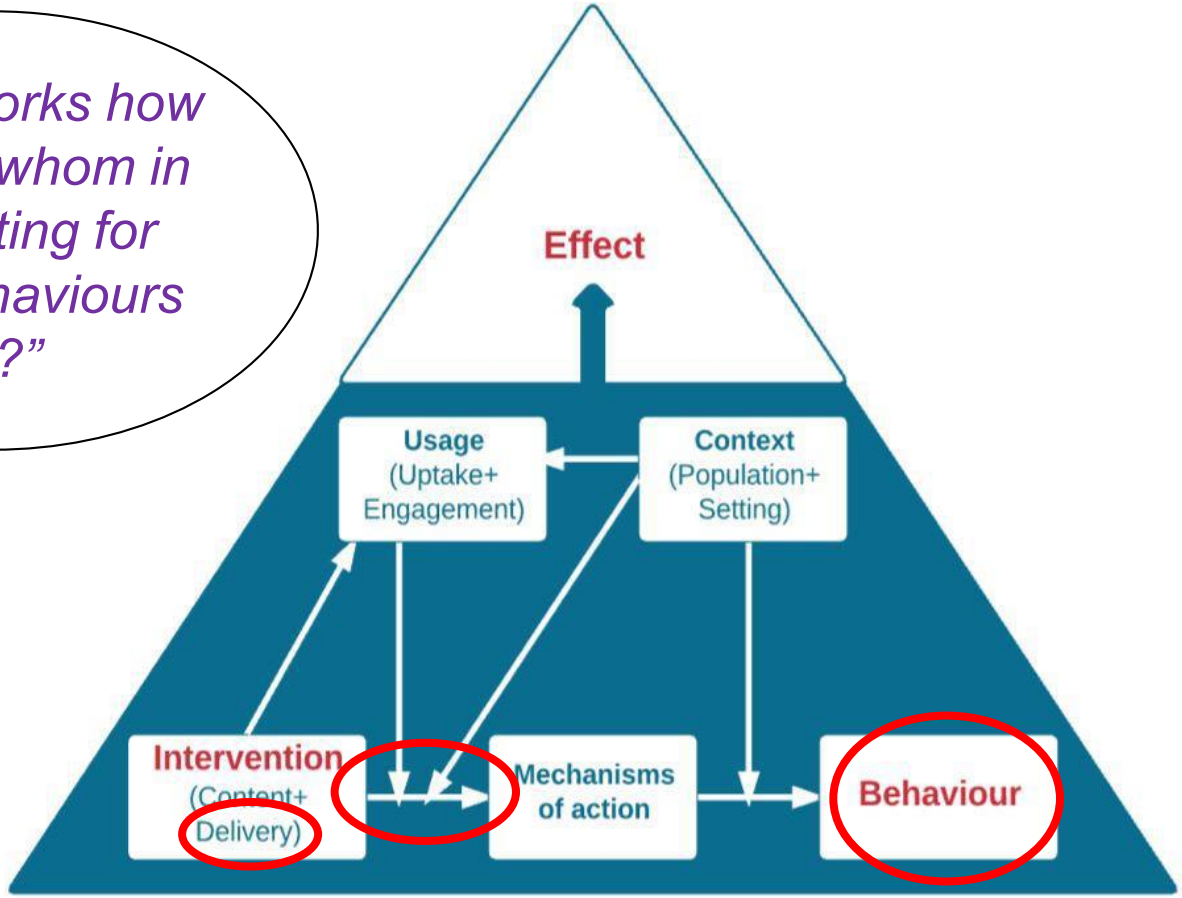
1. Opportunities for advancing behavioural science efficiently
   - improve reporting, fidelity of delivery and use of theory
2. Future vision:
   - developing an ontology of behaviour change interventions
     - Ontology = a systematic method for specifying the relationships between concepts (e.g. BCTs, theoretical constructs, behaviours)

The Behaviour Change Intervention Ontology

West & Michie, 2016

"What works how well, for whom in what setting for what behaviours and why?"

Unorganised world literature



Building the BCI Ontology: mechanisms

'Theory and Techniques' project 2014-17

Marie Johnston
University of Aberdeen

Marijn de Bruin
University of Aberdeen

Susan Michie
University College London

Alex Rothman
University of Minnesota

Mike Kelly
University of Cambridge

Rachel Carey
Research Associate, UCL

Lauren Connell
Research Assistant, UCL

- International Advisory Board

41 experts from 11 countries

1. **Systematic review: what does the literature (>300 articles) tell us?**
2. **Expert consensus: what do 98 experts from 18 countries think?**
3. **Triangulation**

Building the BCI Ontology: behaviours

- Led by Kai Larsen, University of Colorado
  - with Robert West
- 5,461 articles from 3 leading journals in
  - Psychology, Education, Behavioral Medicine, Business, Management, Marketing, Information Systems, Nursing
- 2,375 behavioural variables
  - Extending WHO's International Classification of Functioning, Disability and Health (ICF)
    - Using NIH National Cancer Institute's thesaurus

    >100,000 definitions of biomedical concepts

    https://ncit.nci.nih.gov/ncitbrowser/
    - Created 8 levels of hierarchy

Building the Ontology: modes of delivery

- Categories inductively generated from published research
- A reliable taxonomy with 4 levels
  - With Rachel Carey, Robert West, Fiona Evans (UCL) & Marie Johnston (Aberdeen)

To summarise: the aim is for this work to help …

1. Minimise waste in research
   - Improve reporting, fidelity of delivery and theoretical application
2. Accumulate evidence
   - Importance of replication and incremental advance
   - Organise and integrate past work rather than starting anew or presenting as ‘new’
3. Co-ordinate vs fragment
   - Diversity within co-ordinated frameworks
   - Maximise effectiveness and efficiency of building evidence and advancing theory

Acknowledgments

- Funders including
- Many have contributed to my thinking and work
  - especially …Robert West and Marie Johnston
  - **UK**

    Rona Campbell, Lucy Yardley, Mike Kelly, Jill Francis, Wendy Hardeman, Jamie Brown, David French, Marijn de Bruin, Martin Eccles, Andy Prestwich, Craig Whittington, Robbie Foy, Falko Sniehotta, Charles Abraham, Fabi Lorencatto, Lou Atkins, James Cane
  - **US:** Alex Rothman, Blair Johnson, Kai Larsen, Bill Riley, Karina Davidson, Donna Spruitj-Metz, Eric Hekler, Frank Davidoff
  - **Canada**: Jeremy Grimshaw, Heather Gainforth
  - **Australia**: Paul Glasziou, Ron Borland, Sally Green, Denise O'Connor

Research team

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UCL Centre for Behaviour Change

All proceeds from CBC teaching, training, books and products go to further development