Behaviour Change Taxonomy (Ontology)

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This talk

1. What is an Ontology and where do taxonomies fit in?
2. Why do we need them for behavioural trials?
3. Where have we got to?
4. Next steps
Current state of play

- Behavioural trials
  - estimated 100s published each day
- Considerable investment
- Most have modest and variable effects
  - e.g. reviews from Cochrane, NICE

**How can we improve this situation?**
Behavioural interventions

• 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

• What is in the black box? [content]
• Why do components have their effect? [theory]
• How do they vary across contexts? [theory]
Room for improvement …

• Taken as a whole, our trial reporting and published literature is chaotic
  • Different terms for same concept
  • Same term for different concepts
  • Relationships between concepts either not or poorly specified
• Problem for science and for implementation
### Example: varying terminology in specifying intervention content

<table>
<thead>
<tr>
<th>Title of journal article</th>
<th>Description of “behavioural counseling”</th>
</tr>
</thead>
<tbody>
<tr>
<td>The impact of <em>behavioral counseling</em> on stage of change fat intake, physical activity, and cigarette smoking in adults at increased risk of coronary heart disease</td>
<td>“educating patients about the benefits of lifestyle change, encouraging them, and suggesting what changes could be made” (Steptoe et al. <em>AJPH</em> 2001)</td>
</tr>
</tbody>
</table>

| 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) |
Methodological advances needed to ...

- **Accumulate** 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
      - **Ontologies** useful for this purpose
What is an ontology?

• An ontology = systematic method for specifying concepts and the relationships between them using a “controlled vocabulary”
  • e.g. behaviour change techniques, theoretical constructs, behaviours
• An ontology of behaviour change interventions
  • Includes taxonomies of the key concepts e.g.
    • behaviour change techniques, mechanisms of action, behaviour
The Behaviour Change Intervention Ontology

West & Michie, 2016

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

Effect

Usage (Uptake + Engagement)

Context (Population + Setting)

Mechanism of action

Intervention (Content + Delivery)

Behaviour

Unorganised world literature
Describing content using a shared language

• Behaviour change techniques (BCTs)
  • The smallest components that on their own have the potential to bring about change
  • The ‘active ingredients’ of an intervention
  • Observable and replicable
  • 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 BCTs, Michie et al, Psychology & Health
• Smoking cessation: 53 BCTs, Michie et al, Annals Behavioral Medicine, 2010
• Reducing excessive alcohol use: 42 BCTs, Michie et al, Addiction, 2012
• Condom use: 47 BCTs, Abraham et al, 2012
• General behaviour 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
Results

- 93 clearly labelled, well defined, distinct, precise BCTs
- Hierarchically organised into 16 groupings to improve ease of use

Cane et al, BJHP, 2014

BCT Taxonomy v1: 93 items in 16 groupings
BCTTv1 smartphone app

- Search by BCT label, BCT grouping or alphabetically

Find by search term: BCTs
Welcome

The Behaviour Change Technique Taxonomy — a resource for intervention designers, researchers, practitioners, systematic reviews and all those wishing to communicate the content of behaviour change interventions.

Login

New User?

email

password

login

"Tasks and session materials made a great combination"

Tutorial trainee, Cambridge UK

www.bct-taxonomy.com
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 reviews or factorial designs
  - Identify active ingredients (what)
  - Investigate mechanisms of action (how)
- **Design** interventions
  - BCTs linked to broader intervention frameworks
Feedback and plans for developing BCTTv2

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.
Building the Behaviour Change Intervention Ontology
Theories of behaviour and behaviour change across the social and behavioural sciences: a scoping review
Rachel Davis\textsuperscript{a}, Rona Campbell\textsuperscript{b}, Zoe Hildon\textsuperscript{a}, Lorna Hobbs\textsuperscript{a} & Susan Michie\textsuperscript{a}

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

• 83 theories
  • Summary of original description
  • List of constructs
    • 1725; mean 21, range 5-84
  • Integrating theoretical constructs (‘mechanisms’) into a taxonomy
• Future: Searchable website

Mechanisms
Identifying hypothesised links between BCTs and mechanisms, 2014-17

1. Systematic review: what does the literature (280 articles) tell us?
2. Expert consensus: what do >100 experts from 18 countries think?
3. Triangulation
Building the BCI Ontology: Behaviours

- Led by Kai Larsen, University of Colorado
  - with Robert West, University College London
- 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)
  - We have created 6 levels of hierarchy
The Behaviour Change Intervention Ontology

Effect

Usage
(Uptake + Engagement)

Context
(Population + Setting)

Intervention
(Content + Delivery)

Mechanism of action

Behaviour
Building the BCI 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)
The Human Behaviour-Change Project, 2016-2020:

Building the science of behaviour change for complex intervention development
The Collaboration

• **Behavioural** Science
  - Susan Michie (PI)
  - Marie Johnston
  - Robert West
  - Mike Kelly

• **Information** Science
  - James Thomas

• **Computer** Science
  - John Shaw-Taylor
  - Pol Mac Aonghusa
The Project

• To address the key question in behavioural science:
  • *What works*
    • *how well, for whom, in what setting*
    • *for what behaviours and why?*

• We require
  1. an ‘Ontology’ of behaviour change interventions
  2. A *computational model*, using Artificial Intelligence, to organise the evidence
    • extract information from the vast and rapidly accelerating world scientific literature, using Natural Language Processing, organised into this Ontology
    • generate new behavioural insights by synthesising this evidence
  3. A *user interface* to allow scientists and policy-makers to draw on evidence in real-time to address the key question
The process of collaboration of three sciences

The diagram illustrates the collaborative process of three sciences, involving behavior change experts, designing a BCI ontology informed by scientific literature. This ontology is then applied by BC experts to scientific literature, leading to provisionally annotated scientific literature. The literature is then automatically annotated, and scientific literature is also annotated according to the ontology.

The process continues with the automated annotation of scientific literature, which is fed into an AI system. User feedback informs the development and refinement of the AI system, and the user interface enables people to interact with, query, and interrogate the literature and computerized models. New insights and models about BC interventions are generated through this process.

The diagram also shows the integration of natural language processing and machine learning, which helps the AI system produce models of BC interventions.
Evaluating the Ontology and AI System

- Pilot the ability of the system to maintain updated syntheses of the literature in 4 case studies:
  - Smoking, alcohol consumption, diet, physical activity
    - Start with smoking which has the most extensive & definitive evidence base
- Evaluation criteria include:
  - The adequacy of the new system in comparison with traditional evidence synthesis to provide information that is ..
    - more accurate, extensive, useable and timely
  - The utility of the system as assessed by users
Conclusion

• The aim of this programme of research is to:
  1. Efficiently and rapidly make progress in advancing our understanding of behaviour change
  2. Harness and develop the powers of AI for effectively synthesising research evidence
  3. Make accessible the world literature on behavioural interventions in real-time

• For the benefit of:
  1. All scientists
  2. Policy-makers and intervention designers
Thanks to ....

- Funders

- The many who have contributed to my thinking and work
  - especially ... Robert West and Marie Johnston

- My research team
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University College London

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- UCL Centre for Behaviour Change
  - www.ucl.ac.uk/behaviour-change
- Susan Michie, s.michie@ucl.ac.uk

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